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THE ARRHENIUS EQUATION IN ACCELERATED AGING STUDIES

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The problems of aging tests are discussed and examples are given to show how the use of the Arrhenius equation in treating accelerated aging test data permits the rapid and accurate prediction of the future performance of materials.

INTRODUCTION

IN the development of a new product, chemists frequently are required to determine the potential life of a material, either in storage or in use. Since the requirements of industry necessitate knowing the expected stability as soon as possible, accelerated aging tests must be used. These generally consist of storage at elevated temperatures. Such tests, however, provide information only on the minimum storage time. For this minimum not to be too pessimistic, the temperature of the accelerated test must be close to that of actual conditions in which case little acceleration is achieved. The choice of a temperature then is a perplexing situation.

The need for a standardized accelerated aging test for latex-backed fabrics was voiced recently in this journal (*1*). Furthermore, the AATCC Committee on Anti-Static Finishes has been investigating tests to predict the performance of these finishes after aging. The purpose of this paper is to demonstrate, for those interested in predicting future performance, the value of the Arrhenius equation in dealing with aging studies.

HISTORICAL

Arrhenius (*2*) expressed the effect of temperature on the rate of reaction by the expression

$$\frac{d \ln k}{dT} = \frac{E}{RT^2} \qquad (1)$$

where k is the rate constant of the reaction, R is the universal gas constant, T is the absolute temperature and E is an equation constant. If E is assumed to be independent of temperature, the above expression may be integrated to

$$\ln K = -\frac{E}{RT} + I \qquad (2)$$

where I is an integration constant.

The constant E represents the heat of activation or the energy required to convert unreactive molecules to "active" ones. This quantity may be determined by plotting ln K against 1/T since equation 2 shows the slope of such a plot to be —E/R. The integrated form of the Arrhenius equation is used most frequently to calculate the heat of activation of a reaction.

ADVANTAGES OF USING THE ARRHENIUS EQUATION

The phenomenon of aging, which we attribute to inanimate items, may be treated as a single chemical or physical reaction or a series of reactions of that item with itself or its environment. Since the rate of most of these reactions is dependent on temperature, it is possible to use the Arrhenius equation to solve problems involving the aging of materials. Juve and Schoch (*3*) have applied this concept to the deterioration of rubber and Doyle (*4*) has used this technique to predict the life of a polyester-glass laminate.

As long as the heat of activation is independent of temperature, the logarithm of the rate of reaction will yield a straight line when plotted against the reciprocal of the absolute temperature at which the reaction takes place. Extrapolation of this straight line is the key to the use of the Arrhenius equation in aging studies. In this way data obtained at high temperatures is used to predict stability in temperature regions which would require considerable additional time to determine experimentally. This solves the chemist's dilemma of how to determine maximum storageability in minimum time.

Moreover, the reliability of the predicted storage time can be determined from a statistical study of the correlation coefficient and the confidence limits of a line drawn by the method of least squares through the experimental points.

In using the Arrhenius equation to predict storageability of a material, the chemist first must decide on the point which will be considered the end of the product's useful life (gelation, precipitation, specified degree of discoloration, specified application property, etc). The time to reach this endpoint at a series of constant temperatures then must be determined. This may be done easily if the property can be measured at each temperature as a continuous function of time. The time to the endpoint then may be determined by interpolation.

In Figure 1 are illustrated the results of a comparison of the product stability of a thermosetting resin alone and in combination with two additives. In this case the samples were stored in viscosity tubes at specified temperatures. From time to time the tubes were removed for a short period to a bath where the viscosity was determined by comparison with Gardner-Holdt viscosity standards after which the tubes were returned to the respective storage places. From a plot of viscosity versus time, the time of storage necessary at each temperature to reach the endpoint (viscosity = Z—4) was determined.

One of the advantages of employing the Arrhenius equation is that actual storage times rather than relative stabilities may be predicted. For example, rather than saying that the Additive #1 doubles the shelf life, it is possible by extrapolation of the

curves in Figure 1 to predict with reasonable assurance that Additive #1 will increase the permissible storage period from 2 years to a minimum of 4 years if the resin is stored at 40°F or below.

Figure 1 also points out another advantage of the use of the Arrhenius equation. Because conventional tests do not take into account differences of activation energy, the results of an accelerated test at 130°F may have been used to predict that Additive #2 provides greater stability than Additive #1. It is evident, however, that as the temperature decreases, the relative efficiencies of the additives change so that in the region of normal storage temperatures, Additive #1 may be superior.

Since the Arrhenius equation applies to relatively short temperature intervals, extrapolation of the straight line over large temperature ranges may not always be justified. In such circumstances the high temperature results would give an early indication of what is to be expected. As the tests are complete at intermediate temperatures, the predictions may have to be modified. Finally, the most accurate results would be obtained from the lower temperatures which, of course, would take the longest time. Thus, in obtaining the data the chemist could decide at which point the possible error in accuracy is worth the gain in time. Conventional accelerated tests offer no such choice.

At sufficiently high temperatures, the nature of the aging may change. Components, for example, may be boiled off rather than reacted. The researcher would be warned of such a change by an alteration in the slope of the Arrhenius plot. If a conventional accelerated aging test were run at a temperature where the predominating aging mechanism differs from the normal one, there would be no clue. Then, application of the high temperature data to the milder conditions could yield erroneous results.

AREAS OF USE

YELLOWING——The Arrhenius equation has been employed in a study of the tendency of nylon to yellow (5). Untreated nylon and nylon treated to retard yellowing were heated at constant temperatures for varying lengths of time until it was possible by visual comparisons to estimate the time of heating necessary at each temperature to match the discoloration of a standard piece of heated nylon. This data is presented in Arrhenius equation form in Figure 2. The equation for these lines, calculated by a least squares

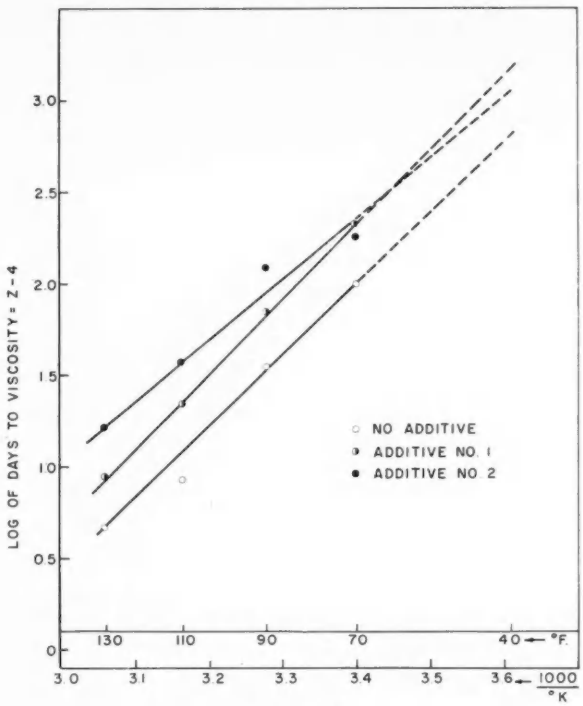

Figure 1

The effect of additives on the time for a thermosetting resin at various temperatures to reach a specified viscosity.

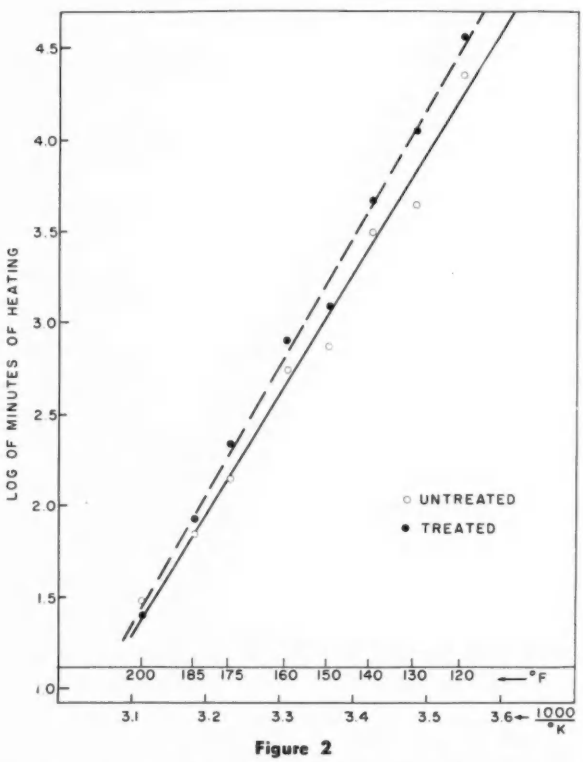

Figure 2

The time-temperature relationship for untreated and treated nylon to reach a specified degree of yellowing.

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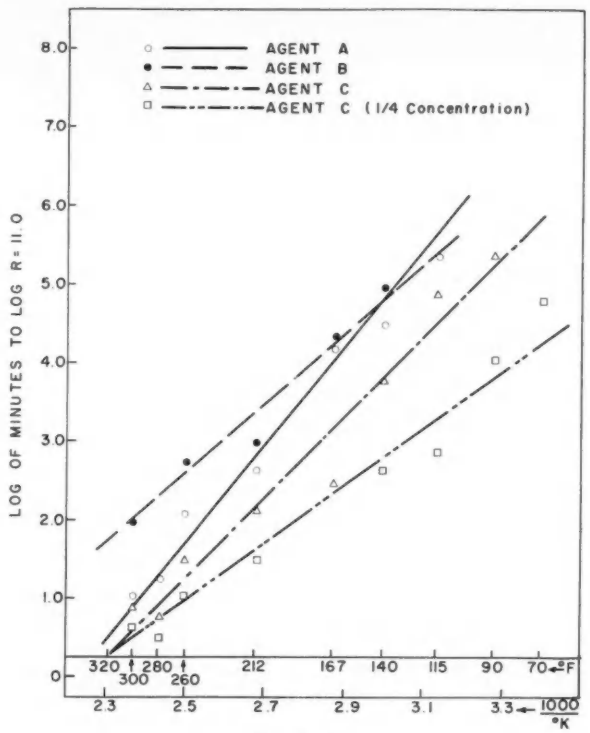

Figure 3

The effect of temperature on the time required for nylon treated with different antistatic agents to reach a surface resistance of 11.0 log ohms per square.

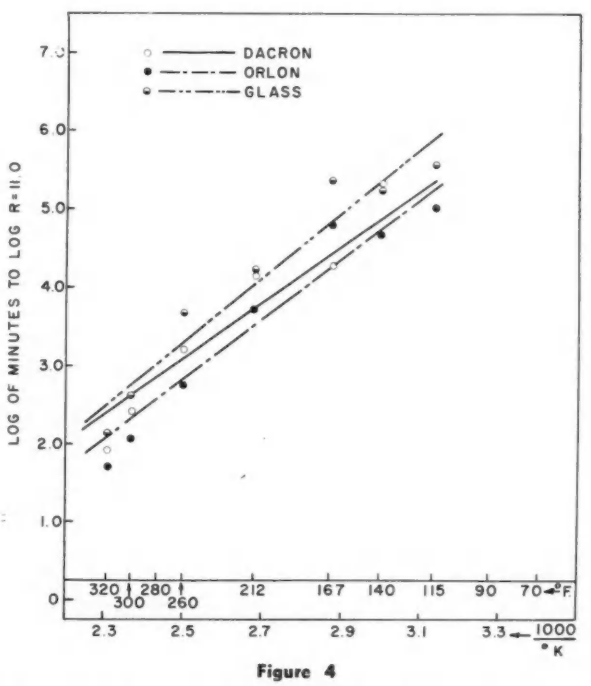

Figure 4

The effect of temperature on the time required for three different fibers treated with one antistatic agent to reach a surface resistance of 11.0 log ohms per square.

analysis are:

$$\text{Untreated Nylon: } \log t \text{ (minutes)} = \frac{6530}{T(°K)} - 13.4$$

$$\text{Treated Nylon: } \log t \text{ (minutes)} = \frac{7260}{T(°K)} - 14.9$$

It may be computed that at 100°C it would take untreated nylon nine days and treated nylon twenty-eight to reach the same degree of yellowing. Extrapolating the curve to 30°C indicates that untreated and treated nylon would require 300 and 2400 years respectively to reach the degree of yellowing represented by our standard. In this way the use of the Arrhenius equation provides data which would not otherwise be readily attainable.

It may be noted that, where there are deviations from the calculated lines in Figure 2, the points for both fabrics consistently deviate in the same direction. Since both fabrics were stored simultaneously at the various temperatures, these Arrhenius equation plots suggest that the temperatures are not known as accurately as might have been expected. Such information is another benefit derived from these plots.

ANTISTATIC EFFECT——Some antistatic agents lose effect after application to a fabric. To study the phenomenon, three antistatic agents of dissimilar chemical structures were applied at equal concentrations to nylon. One of these materials also was applied at the same concentration to Orlon, Dacron, and glass fabrics and at one-quarter the concentration to nylon. The fabrics were stored in various ovens at different temperatures. From time to time a sample was removed from the oven and tested for electrical resistivity according to AATCC Tentative Test Method 76-54 (*6*).

The time to reach a reading of 11.0 log ohms per square was determined by interpolation from a plot of log R versus time. Figures 3 and 4 show the general adherence to the Arrhenius equation from 320°F to room temperature. It may be noted that these temperatures represent a variety of different types of ovens so that such factors as air velocity, light, gases, etc, do not appear to have a significant effect on the aging phenomenon.

BATH LIFE——A shorter version of a product stability study is the evaluation of the bath stability of a catalyzed thermosetting resin. Data on different bath concentrations of a resin and a catalyst are indicated in Figure 5. The end point was

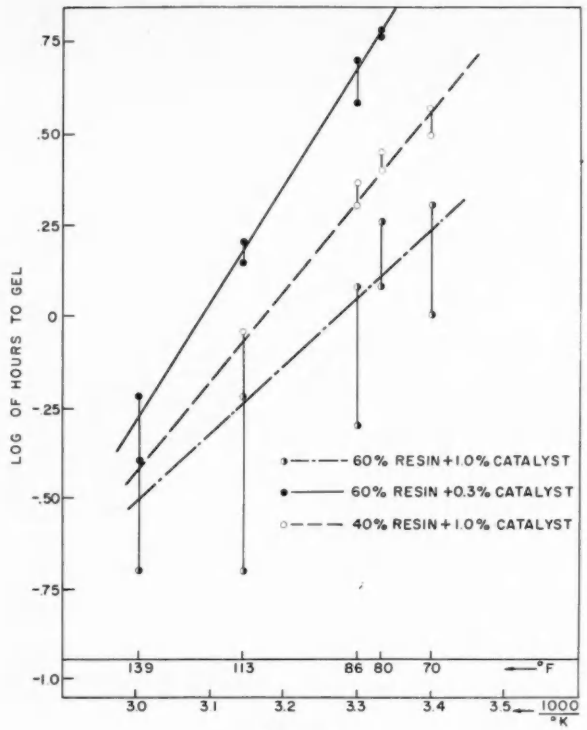

Figure 5

The effect of resin and catalyst concentration on the average gel time of a thermosetting resin at various temperatures.

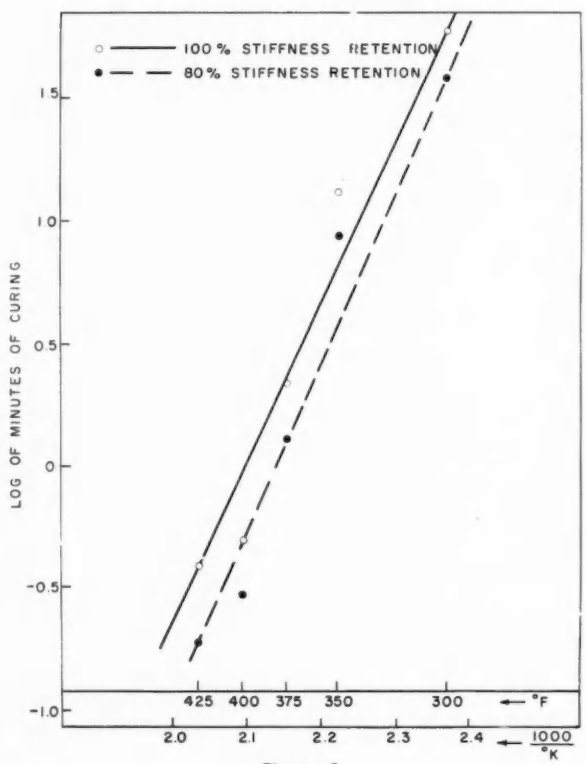

Figure 6

The relationship of the stiffness retention of polyacrylic acid on nylon to the time and temperature of curing.

measured as the range between the last observation of a fluid bath and the first observation of a gel. Curves such as these are useful in studies of the relative effects of resin concentration, catalyst concentration and temperature on the bath life of a product. Where bath life exceeds the normal working day, it can be measured by interpolation on curves such as these.

CURING STUDIES——One instance where instability rather than stability may be sought is in measurements of the speed of curing of a finish. In such instances the Arrhenius equation permits the accurate translation of data from one temperature to another.

Nuessle and Crawford (7) studied the conditions of cure necessary to fix polyacrylic acid to nylon and presented curves of stiffness retention versus time for five curing temperatures, 425°, 400°, 375°, 350°, and 300°F. If it were desired to cure at some other temperature, this data could be transformed most easily by use of Arrhenius equation plots. Data for 80% and 100% stiffness retention after washing are shown in Figure 6.

CONCLUSIONS

Thus, in several different types of studies of the aging of material, the application of the Arrhenius equation permits the rapid and accurate prediction of performance. It is hoped that those concerned with the establishment of accelerated test methods, particularly those intended to become standard methods, will consider this approach to the problem.

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EFFECT OF DYE AND ACID VALANCES IN WOOL DYEING

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INTRODUCTION

In a previous article (*1*) it was shown that the classical diffusion formula, or at least the relationships derived from it, was inadequate to explain quantitatively the rate of dyeing of acid dyes on wool and nylon. This was most strikingly manifested by obtaining a sigmoid curve when E/E_x is plotted against $t_{1/2}$ and by the noncorrespondence of the straight-line portion of the curve with the period of ring-dyeing. Since it is believed, nevertheless, that diffusion should play an important role in dyeing, it was decided that the hypothesis should be tested that classical diffusion is greatly modified by some other factor. This "other factor" was believed to be electrical in nature since the dye ion is negatively charged and the fiber in acid solution is positively charged. It is obvious, however, that this positive-negative force might act in two opposite ways:

a) The undyed but ionized fiber ahead of the dye boundary would tend to attract dye ions and thus increase dyeing rate.

b) The incompletely dyed fiber which must be passed by the diffusing dye ions to reach the undyed portion of the fiber would also attract the dye ions and tend to reduce the rate of diffusion; this would result in a decrease in dyeing rate.

In order to estimate the net electrical effect and to measure the relative effects of the two mechanisms above, it was decided to vary the valence of the dye anion without changing its chemical nature or appreciably changing its molecular volume; and also to vary the degree of ionization of the fiber by changing the nature of the acid used with the dye, this could be done by varying the valence of the acid anion. First attempts were made as near as possible to practical dyeing conditions, but this introduced other variables so that ultimately the dyeings were made under somewhat impractical, idealized conditions. Since the results of the dyeings were to be used to test hypotheses, the accuracy of the data was required to be high and of known magnitude; therefore dyeings were done in triplicate and standard errors calculated. The degree of reproducibility of E/E_x was found to be remarkably good—the standard error was never more than 1% and averaged 0.3 to 0.5%, the standard error at equilibrium was lowest of all and ranged from zero to 0.2%.

TABLE I
Iso-molar dyebaths

Dyes = 0.0006 mole per liter
D1 = *CI* 63000
D2 = *CI* 63010
Acids = 0.004 mole per liter
A1 = hydrochloric acid
A2 = sulfuric acid
Salts = 0.012 mole per liter
A1 = sodium chloride
A2 = sodium sulfate
Dyebath = 100 times the weight of fiber
Fiber = chopped wool
Agitation = moderate

Time—minutes t	*Relative Exhaustion—E/E∞* D1A1	D2A1	D1A2	D2A2
1	.051	.025	.083	.062
4	.142	.126	.203	.145
9	.372	.281	.313	.253
16	.604	.487	.490	.395
25	.793	.706	.652	.535
36	.909	.867	.795	.695
49	.972	.955	.886	.819
64	.986	.990	.910	.910
81	.992	.995	.971	.952
100	.996	1.000	.989	.979
121	1.000		.998	.992
144			1.000	.997
169				1.000
E∞	.988	.995	.959	.968
$t_{1/2}$	12.3	16.4	16.8	22.6

TABLE II
Iso-hydric dyebaths

Dyes = 0.0006 mole per liter
D1 = *CI* 63000
D2 = *CI* 63010
Acids and salts = to give initial pH = 2.22 and final pH = 2.94 to 3.36
A1 = hydrochloric acid and sodium chloride
A2 = sulfuric acid and sodium sulfate
Dyebath = 100 times the weight of fiber
Fiber = chopped wool
Agitation = moderate

Time—minutes t	*Relative Exhaustion—E/E∞* D1A1	D2A1	D1A2	D2A2
1	.267	.265	.261	.038
4	.527	.465	.367	.218
9	.788	.844	.557	.447
16	.963	.973	.674	.673
25	.989	.981	.863	.837
36	.998	1.000	.900	.929
49	1.000		.974	.977
64			.997	.980
81			1.000	.997
100				.999
121				1.000
E∞	.992	.996	.925	.961
$t_{1/2}$	3.7	4.5	7.3	10.0

EXPERIMENTAL RESULTS

Two dyes, Acid Blue 43 and Acid Blue 45 (*CI* 63000 and 63010), were used; these dyes are both anthraquinone dyes, identical in structure except that Acid Blue 43 has one sulfonic group and Acid Blue 45 has two sulfonic acid groups; these are identified hereafter as D1 and D2. Acids used were hydrochloric acid (A1) and sulfuric acid (A2); when salts were used in the dyebath, sodium chloride was used with A1 and sodium sulfate with A2. All dyeings were done at 60°C under reflux, with a volume of dyebath equal to one hundred times the weight of fiber. Mechanical agitation was used of a rate high enough so that variations in agitation produced no appreciable difference in dyeing rates. In all cases, the previously cleaned fiber was cut up into approximately one-quarter inch lengths to eliminate any packing or geometrical effects (*2*).

The results of the first set of dyeings (*3*), hereafter referred to as "iso-molar dyebaths", are given in Table I where the relative exhaustions

$\alpha = E/E_\infty$ are given.
E = exhaustion of dye as % of original dye in bath
E_∞ = exhaustion at equilibrium

For each dyeing, E_x is given as a parameter of equilibrium and $t_{1/2}$ as a parameter of dyeing rate.

$t_{1/2}$ = time (minutes) when $\alpha = .5$

Time of half-dyeing has been arbitrarily used as a measure of dyeing rate by many investigators and is so used at this point; it will be shown later, however, that $t_{1/2}$ is actually a parameter of great theoretical importance. In these dyeings the *initial* dyebaths are all of the same molar concentrations and differ only in the valences of the dye and acid anions.

The results of the second set of dyeings (*4*), hereafter referred to as "iso-hydric dyebaths", are given in Table II. In these dyeings the initial dyebaths are of the same molar concentration of dye but the acid and salt concentrations were adjusted by trial so that the *initial* dyebath had a pH = 2.22 and changed during the dyeings at an equal rate. Since the dyeings came to dye equilibrium at different times, the final pH differed slightly in each case. It is worthy

TABLE III
Iso-hydric fibers

Dyes = 0.0006 mole per liter
D1 = *CI* 63000
D2 = *CI* 63010
Acids = to give $H_f = 1.0$ and $H_f = 0.5$
A1 = hydrochloric acid
A2 = sulfuric acid
Salts = none
Dyebath = 100 times the weight of fiber
Fiber = chopped wool
Agitation = very high

Time—minutes t	Relative Exhaustion—E/E_∞ D1A1 1.0	D1A1 0.5	D2A1 1.0	D2A1 0.5	D1A2 1.0	D1A2 0.5	D2A2 1.0	D2A2 0.5
.25	.168	.172	.206	.213	.176	.097	.158	....
1.00	.356	.340	.416	.377	.310	.186	.298	.151
2.25	.567	.526	.606	.582	.451	.312	.433	.261
4.00	.761	.716	.785	.743	.605	.425	.575	.402
6.25	.907	.873	.923	.916	.752	.546	.715	.527
9.00	.969	.977	.978	.995	.861	.665	.836	.647
12.25	.989	.998	.995	1.00	.936	.762	.924	.785
16.00	.993	1.00	1.00		.970	.856	.971	.875
20.25	.997				.990	.927	.983	.951
25.	1.00				.995	.958	.990	.983
36.					1.00	.991	.994	.993
49.						.998	.995	.996
64.						1.00	1.00	1.00
E_∞	.991	.999	.997	.996	.992	.993	.996	.997
$t_{1/2}$	1.77	1.99	1.49	1.68	2.62	5.30	3.00	5.75

of note that when dye equilibrium had been reached, as shown by three successive determinations of dye concentration showing no change, the dyebath was not yet at complete equilibrium, since the pH of the solutions were still changing (although only slowly).

Up to this time it has been assumed, based on the work of Eloed (*7*), that the hydrogen ions (accompanied by acid anions) diffused into the fiber so much more rapidly than dye ions that the fiber ahead of the dye boundary was essentially constant in acid concentration. This would mean that dye diffusion rate, being much slower than acid diffusion, would be the rate-governing mechanism. The results of the iso-hydric dyebath measurements however, and particularly the nonconstancy of the pH at dye equilibrium, showed that while an acid may diffuse very rapidly in the initial stages of dyeing, it ultimately becomes slower than dye diffusion and therefore neither one alone is rate-determining but both must be considered. It should also be noted that diffusion of acid into the wool fiber would cause a Donnan Membrane mechanism resulting in a swelling of the fiber; this in turn would mean that the *mechanical* resistance of the fiber to dye diffusion would alter during the acid diffusion.

In order to eliminate the interference of acid diffusion rate with dye diffusion rate, other dyeings were made (*5, 6*), the results of which are given in Table III. In these dyeings, referred to as "iso-hydric fiber" dyeings, no salts were used and the fibers were brought to equilibrium with the acid solutions before the dye was added; for additional information, two levels of acid equilibrium adsorption were used, $H_f = 1.0$ and $H_f = 0.5$.

H_f = concentration of hydrogen ion in the fiber at equilibrium equivalents per kilogram

A little calculation will show that $H_f = 0.5$ is nearest the acid concentrations of the iso-molar solutions and the iso-hydric solutions. Previous determinations (*5, 6*) had shown that the saturation value of the wool used, at 60°C, is 1.0 equivalent of acid per kilogram of wool fiber.

COMPARISON OF DYEING RATES

Table IV gives a comparison of the $t_{1/2}$ values for the various series of dyeings. The effect of dye valence (z) is shown by the ratio of the $t_{1/2}$ values for D2A1 compared to D1A1 and for D2A2 compared to D1A2. The effect of acid valence (y) is shown by the ratio of the $t_{1/2}$ values for D1A2 compared to D1A1 and for D2A2 compared to D2A1. In each case, therefore, the ratio given is the amount by which the $t_{1/2}$ value is increased (or the rate decreased) by using a divalent ion as compared to a monovalent ion. It may be noted that in all cases the effect of a change in acid valence is greater than the effect of a change in dye valence. This difference, however, is smallest for the iso-molar dyebath, and greatest for the iso-hydric fibers; it is intermediate for the iso-hydric dyebath. The iso-hydric dyebath series was run primarily because the effect of changing the valence in iso-molar baths might be attributed to differences in pH rather than to valence changes; the fact that when nearly the same pH is used, regardless of valence, the effect of valence becomes more pronounced rather than less indicates that a real valence effect is present.

TABLE IV
Ratio of $t_{1/2}$ values

	Effect of dye valence (z) D2A1/D1A1	D2A2/D1A2	Effect of acid valence (y) D1A2/D1A1	D2A2/D2A1
Iso-molar dyebath	1.33	1.34	1.37	1.38
Iso-hydric dyebath	1.21	1.37	1.97	2.22
Iso-hydric fibers $H_f = 0.5$	0.84	1.08	2.66	3.42
Iso-hydric fibers $H_f = 1.0$	0.84	1.14	1.48	2.00

It may be noted that in determining the effect of "z" in the case of iso-molar solutions the same change in $t_{1/2}$ occurs for a change in the dye regardless of the acid used; in the other two cases a greater change occurs in the case of two dyes compared using a divalent acid than when the same two dyes are compared using a monovalent acid. Similar effects may be noted in the determination of the "y" effects.

Figures 1 and 2, where a (or E/E_x) is plotted against square root of time, also show that the effect of a change in acid valence is greater than the effect of an equal change in dye valence; this is illustrated for both iso-molar solutions and for iso-hydric fibers. In addition, Figure 2 shows that, in the case of iso-hydric fibers, the relationship is a straight line for approximately the first half of the dyeing and has no initial "toe" at very short times. The significance of this "toe" has been previously discussed (*1*) and it now appears that the toe is absent and the shape of the curve conforms to the classical diffusion theory when the fiber is initially at equilibrium with the acid; that is, when *only* dye diffusion into the fiber occurs during the dyeing process. It further follows that the initial toe is due to the complication of acid diffusion into the fiber occurring simultaneously with dye diffusion.

Since it is a simplified mechanism, the case of iso-hydric fibers offers the best chance of deriving a mathematical expression of dyeing rate, and will be further analyzed.

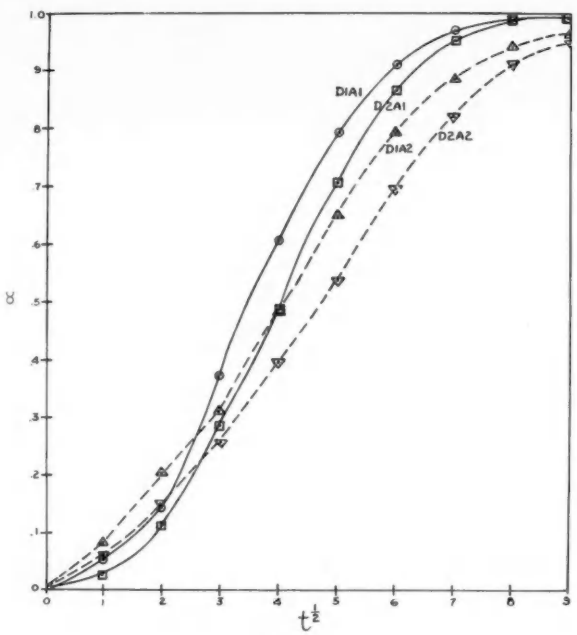

Figure 1
Iso-molar dyebaths

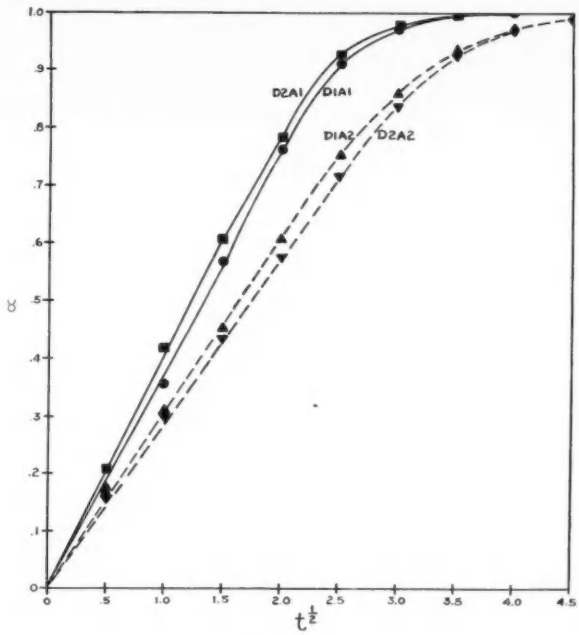

Figure 2
Iso-hydric fibers ($H_f = 1.0$)

DYE CONCENTRATION GRADIENT IN THE FIBER

The fact that "ring-dyeing" occurs shows that the dye advances in the fiber from the surface to the axis of the fiber as a widening belt and that some sort of a dye concentration gradient exists between the surface and the center of the fiber. Speakman (*8*) has shown that dyeing occurs from a layer of solution of constant concentration and in view of the rapidity of adsorption it would further follow that the surface of the fiber is also at a constant concentration during the dyeing. If so, this constant concentration cannot logically be any other concentration than the final equilibrium concentration (C_{fz}). As the dyeing proceeds, there eventually comes a time (t_a) when the dye first reaches the axis of the fiber; this occurs when $E/E_\infty = a_a$. At the time t_a, then, the concentration gradient in the fiber will be as shown by one of the three relationships shown in Figure 3, that is,

$$y = kx^n \text{ or } x = my^{1/n}$$

where y = concentration of dye in fiber at any point, moles per kilogram; x = distance of the point from fiber axis, centimeters; k,m,n = constants.

In Figure 3, A represents the case where n<1, B represents n = 1, and C represents n>1.

We may assume further that when x = r, $y = C_{fz}$
so that

$$r = m\,C_{f\infty}^{1/n} \qquad \text{or} \qquad m = \frac{r}{C_{f\infty}^{1/n}}$$

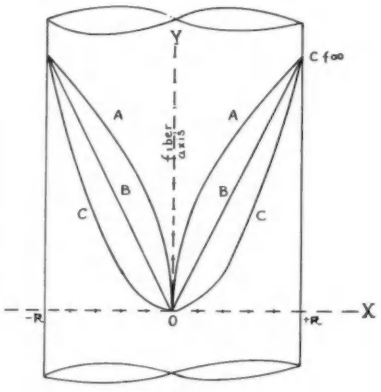

Figure 3
Fiber concentration gradients at t_a

If we further assume that the wool fiber is a cylinder of radius "r", then the total amount of dye in the fiber is the integral of the gradient curve and is given by the difference between the volume of revolution about OY (V) of the gradient curve and the volume of revolution of the equilibrium curve (V_z)

$$V = \pi \int_o^{C_{f\infty}} x^2\,dy$$

$$\text{or } V = \pi \int_o^{C_{f\infty}} m^2 y^{2/n}\,dy = \frac{\pi r^2}{C_{f\infty}^{2/n}} \int_o^{C_{f\infty}} y^{2/n}\,dy$$

$$\text{then } V = \frac{\pi r^2}{C_{f\infty}^{2/n}} \cdot \frac{C_{f\infty}^{2/n+1}}{2/n+1} = \pi r^2 C_{f\infty} \cdot \frac{n}{2+n}$$

If the fiber were fully dyed to equilibrium, the concentration throughout the fiber would be $C_{f\infty}$ and the corresponding volume of revolution (V_∞) would be $\pi r^2 C_{f\infty}$, so that

$$V_\infty - V = \pi r^2 C_{f\infty} - \pi r^2 C_{f\infty} \cdot \frac{n}{2+n}$$

$$= \pi r^2 C_{f\infty} \left(1 - \frac{n}{2+n}\right)$$

Then the fractional dyeing a_a would be

$$a_a = \frac{V_\infty - V}{V_\infty} = 1 - \frac{n}{2+n}$$

$$\text{or } a_a = \frac{2}{2+n}$$

Selecting some specific values of "n," we see that:

when n = 0.5	$a_a = .800$	$t_a = t_{4/5}$
when n = 1.0	$a_a = .667$	$t_a = t_{2/3}$
when n = 2.0	$a_a = .500$	$t_a = t_{\frac{1}{2}}$

If we now use the various t_a values as parameters and plot a against t/t_a, then that value of "n" which brings the various dyeings (iso-hydric fibers) into a single curve should be *nearest* to representing the concentration gradient in the fiber. Trial on the data showed that the use of $t_{\frac{1}{2}}$ was better than $t_{\frac{2}{3}}$ and very much better than $t_{\frac{4}{5}}$; it was therefore decided that the concentration gradient curve was represented by a concave-upward curve *similar* to curve C in Figure 3 and that (at least to a first approximation) it could be mathematically represented by

$$y = kx^2$$

at a time when

$$a = .50 \text{ and } t = t_{\frac{1}{2}}.$$

DERIVATION OF RATE EQUATIONS

In the preceding section one specific instant in the course of the dyeing was taken. If we assume that the same value of "n" applies throughout the whole dyeing: that is, that the concentration gradient follows the same mathematical relationship throughout; then the simpler relationship of the preceding section must be replaced by

$$y - C_a = kx^2$$

where C_a = concentration of dye at fiber axis at any instant

and Figure 4 illustrates the relationships at three different times of dyeing. Figure 4A shows the concentration gradient before half-dyeing, 4B at half-dyeing, and 4C after half-dyeing. In 4A, C_a is negative (and not real); in 4B, $C_a = O$; and in 4C, C_a is positive and real. We have also the further fact, as before, that when $x = r$, $y = C_{f\infty}$
so that

$$C_{f\infty} - C_a = kr^2 \text{ or } k = \frac{C_{f\infty} - C_a}{r^2}$$

then $$y = C_a + \frac{(C_{f\infty} - C_a)x^2}{r^2} \quad \ldots\ldots(1)$$

and $$x^2 = \frac{r^2 (y - C_a)}{C_{f\infty} - C_a} \quad \ldots\ldots(2)$$

According to the Fick Equation for diffusion,

$$\frac{dC_f}{dt} = DA\frac{dy}{dx}$$

where $\frac{dC_f}{dt}$ represents the amount of dye passing a point per unit time, A is the cross-sectional area of the solid at the point of measurement, and dy/dt is the concentration gradient at the point. D is the apparent diffusion coefficient. The most convenient point is the surface of the fiber, so that dC_f/dt represents the increase in concentration of dye in the fiber (moles per kilogram), A is the fiber area per kilogram (under dyeing conditions), and dy/dx is the concentration gradient at the surface of the fiber.
Differentiating (1), we get

$$\frac{dy}{dx} = \frac{2 (C_{f\infty} - C_a)\, x}{r^2}$$

and evaluating this at the surface (x = r), we get

$$\frac{dy}{dx} \text{ (at surface)} = \frac{2}{r} (C_{f\infty} - C_a)$$

Substituting this into the Fick relationship:

$$\frac{dC_f}{dt} = \frac{2DA}{r} (C_{f\infty} - C_a)$$

Then, since $C_f/C_{f\infty} = \alpha$

$$\frac{d\alpha}{dt} = \frac{1}{C_{f\infty}} \cdot \frac{dC_f}{dt}$$

or $$\frac{d\alpha}{dt} = \frac{2DA}{rC_{f\infty}} (C_{f\infty} - C_a) \quad \ldots\ldots(3)$$

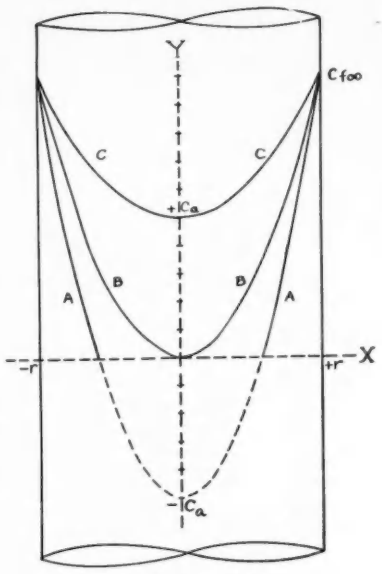

Figure 4
Fiber concentration gradients during dyeing

As in the preceding section,

$$\alpha = \frac{V_\infty - V}{V_\infty} = 1 - \frac{V}{V_\infty}$$

or $$1 - \alpha = \frac{V}{V_\infty}$$

As before $$V = \pi \int_{y_1}^{y_2} x^2\, dy$$

$$= \frac{\pi r^2}{C_{f\infty} - C_a} \int_{y_1}^{y_2} (y - C_a)\, dy$$

and $$V_\infty = \pi r^2 C_{f\infty}$$

Then $$1 - \alpha = \frac{1}{\pi r^2 C_{f\infty}} \cdot \frac{\pi r^2}{(C_{f\infty} - C_a)} \int_{y_1}^{y_2} (y - C_a)dy$$

or $$1 - \alpha = \frac{1}{C_{f\infty} (C_{f\infty} - C_a)} \left[\frac{y^2}{2} - C_a \cdot y\right]_{y_1}^{y_2} \quad \ldots\ldots(4)$$

It should be noted that the above equation applies to the whole dyeing period but that the limits of integration during the first half of the dyeing are $y_1 = O$, $y_2 = C_{f^\infty}$ and during the second half of the dyeing are $y_1 = C_a$, $y_2 = C_{f^\infty}$. The two sets of limits are *not* consecutive in value and therefore a separate substitution must be made for each half of the dyeing.
For the first half of the dyeing:

$$t = 0 \text{ to } t = t_{\frac{1}{2}},\ \alpha = 0 \text{ to } \alpha = .5$$
$$y_1 = 0 \text{ and } y_2 = C_{f\infty}$$

Then

$$1 - \alpha = \frac{1}{C_{f\infty}(C_{f\infty} - C_a)} \left[\frac{C_{f\infty}^2}{2} - C_{f\infty} \cdot C_a\right]$$

$$= \frac{1}{C_{f\infty} - C_a}\left[\frac{C_{f\infty}}{2} - C_a\right]$$

$$= \frac{C_{f\infty} - 2C_a}{2(C_{f\infty} - C_a)}$$

$$2(1 - \alpha) = \frac{(C_{f\infty} - C_a) - C_a}{(C_{f\infty} - C_a)} = 1 - \frac{C_a}{C_{f\infty} - C_a}$$

$$\frac{C_a}{C_{f\infty} - C_a} = 1 - 2(1 - \alpha)$$

$$1 + \frac{C_a}{C_{f\infty} - C_a} = 2 - 2(1 - \alpha) = 2\alpha$$

$$\frac{C_{f\infty} - C_a + C_a}{C_{f\infty} - C_a} = 2\alpha = \frac{C_{f\infty}}{C_{f\infty} - C_a}$$

$$C_{f\infty} - C_a = \frac{C_{f\infty}}{2\alpha} \quad \ldots\ldots(5a)$$

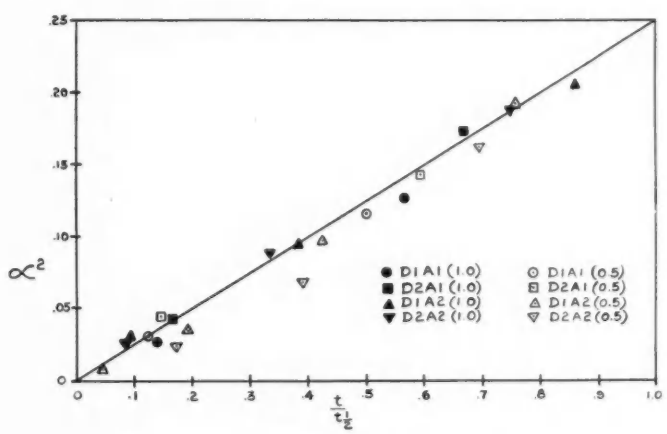

Figure 5
Test of theory, first half of dyeings, iso-hydric fibers
Line = theory; points = data

For the second half of the dyeing:
$t = t_{\frac{1}{2}}$ to $t = t_\infty$, $a = .5$ to $a = 1.0$

$y_1 = C_a$ and $y_2 = C_{f\infty}$

Then

$$1-\alpha = \frac{1}{C_{f\infty}(C_{f\infty}-C_a)}\left[\left(\frac{C_{f\infty}^2}{2}-C_a \cdot C_{f\infty}\right) - \left(\frac{C_a^2}{2}-C_a^2\right)\right]$$

$$= \frac{1}{C_{f\infty}(C_{f\infty}-C_a)}\left[\frac{C_{f\infty}^2}{2}-C_a \cdot C_{f\infty}+\frac{C_a^2}{2}\right]$$

$$= \frac{1}{2C_{f\infty}(C_{f\infty}-C_a)}\left[C_{f\infty}^2-2C_a \cdot C_{f\infty}+C_a^2\right]$$

$$= \frac{C_{f\infty}-C_a}{2C_{f\infty}}$$

$$C_{f\infty}-C_a = 2C_{f\infty}(1-\alpha) \qquad \ldots\ldots (5b)$$

Substituting (5a) into (3) and integrating:

$$\frac{d\alpha}{dt} = \frac{2DA}{rC_{f\infty}} \cdot \frac{C_{f\infty}}{2\alpha} = \frac{DA}{r} \cdot \frac{1}{\alpha}$$

$$\int_0^\alpha \alpha d\alpha = \frac{DA}{r}\int_0^t dt$$

$$\frac{\alpha^2}{2} = \frac{DA}{r} \cdot t$$

$$\alpha^2 = \frac{2DA}{r} \cdot t \qquad \ldots\ldots (6a)$$

Substituting (5b) into (3) and integrating:

$$\frac{d\alpha}{dt} = \frac{2DA}{rC_{f\infty}} \cdot 2C_{f\infty}(1-\alpha) = \frac{4DA}{r}(1-\alpha).$$

$$\int_{.5}^\alpha \frac{d\alpha}{1-\alpha} = \frac{4DA}{r}\int_{t_{\frac{1}{2}}}^t dt$$

$$-\ln(1-\alpha)+\ln .5 = \frac{4DA}{r}(t-t_{\frac{1}{2}})$$

$$\ln(1-\alpha) = \ln .5 - \frac{4DA}{r}(t-t_{\frac{1}{2}}) \qquad \ldots\ldots (6b)$$

$$\text{or } \log(1-\alpha) = \log .5 - \frac{4DA}{2.3r}(t-t_{\frac{1}{2}}) \qquad \ldots (6c)$$

Returning to (6a), and because when $\alpha = .5$, $t = t_{\frac{1}{2}}$

$$\frac{1}{4} = \frac{2DA \cdot t_{\frac{1}{2}}}{r}$$

$$\text{or } \frac{DA}{r} = \frac{1}{8t_{\frac{1}{2}}} = \frac{.125}{t_{\frac{1}{2}}} \qquad \ldots\ldots (7)$$

Substituting (7) into (6a):

$$\alpha^2 = .25t/t_{\frac{1}{2}} \text{ or } \left(\frac{\alpha}{.5}\right)^2 = t/t_{\frac{1}{2}} \qquad \ldots\ldots (8a)$$

Substituting (7) into (6b):

$$\ln(1-\alpha) = \ln .5 - .5\left(\frac{t}{t_{\frac{1}{2}}}-1\right)$$

$$\text{or } \frac{t}{t_{\frac{1}{2}}}-1 = \ln\left(\frac{.5}{1-\alpha}\right)^2 \qquad \ldots\ldots (8b)$$

$$\text{also } \log(1-\alpha) = \log .5 - \frac{.5}{2.3}\left(\frac{t}{t_{\frac{1}{2}}}-1\right)$$

$$\text{or } \log(1-\alpha) = \log .5 - .217\left(\frac{t}{t_{\frac{1}{2}}}-1\right) \qquad \ldots (8c)$$

It should be noted that equations (6a) and (8a) are mathematically equivalent to $a = kt^{\frac{1}{2}}$ and that therefore a straight line should be obtained when plotting a against $t^{\frac{1}{2}}$ for the first half of the dyeings, but also that a *single* straight line should result for all the iso-hydric fiber dyeings if a is plotted against $(t/t_{\frac{1}{2}})^{\frac{1}{2}}$ or, what is the same thing, when a is plotted against $t/t_{\frac{1}{2}}$. This test of theory is shown in Figure 5 and it may be seen that agreement between data and theory is quite good, the greatest deviation being with the D2A2(0.5) dyeing. In contrast to this, Figure 6 shows a similar test of the data for iso-molar solutions and it may be seen that systematic deviation occurs. Even here, however, the results for the same acid but different dyes fall on the same curve—indicating that the deviations from theory are due to the acid and not to the dye.

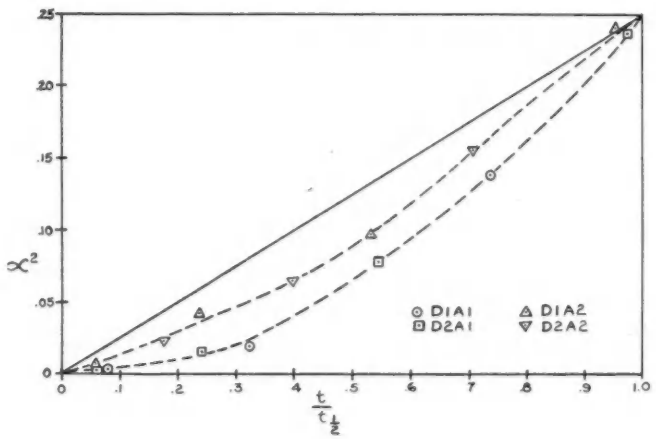

Figure 6
Test of theory, first half of dyeings, iso-molar dyebaths
Line = theory; points = data

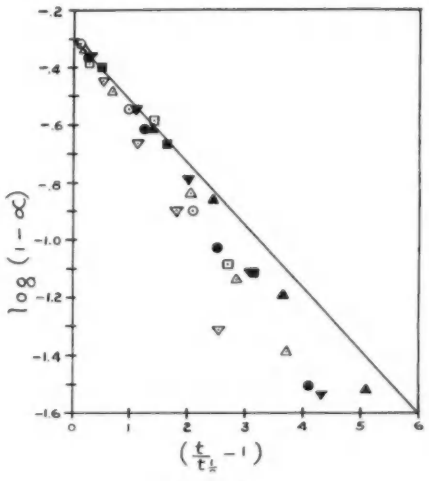

Figure 7
Test of theory, last half, iso-hydric fibers
Line = theory; points = data
Symbols as in Figure 5

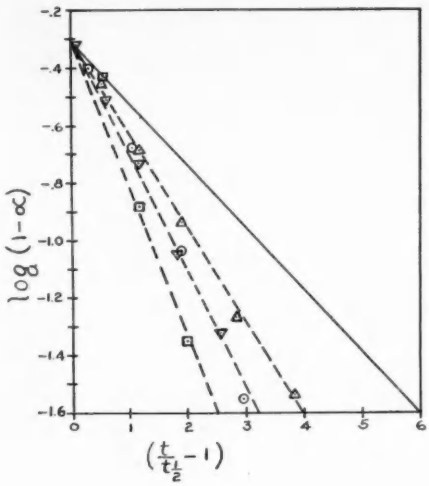

Figure 8
Test of theory, last half, iso-molar dyebaths
Line = theory; points = data
Symbols as in Figure 6

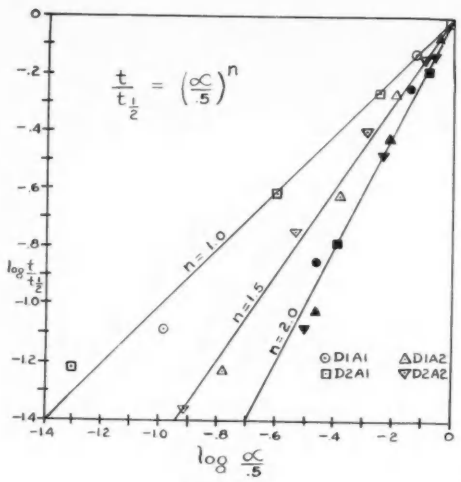

Figure 9
Comparison of iso-molar and iso-hydric, first half
Solid = iso-hydric fiber ($H_f = 1.0$), open = iso-molar baths

A test of equation (8c) is given in Figure 7 for iso-hydric fibers and it may be seen that agreement is very good up to a value of

$$\left(\frac{t}{t_{\frac{1}{2}}}-1\right)$$

of 2.0; beyond this the agreement is only fair; again we see that the D2A2(0.5) dyeing shows the greatest deviation. Figure 8 shows a similar plot for the iso-molar solutions and here the deviations again are considerable and systematic. In contrast to Figure 6, however, it may be seen that the D1A1 and D2A2 dyeings (where z=y) fall on a middle line between D2A1 (z>y) and D1A2 (z<y).

Since the iso-hydric fiber dyeings agree so well with theory and the iso-molar solution dyeings (which are most nearly like practical dyeings) show *systematic* differences from theory, the possibility was explored that the iso-molar dyeings might differ from theory only in the magnitude of the theoretically fixed constants. The theoretical relationship for the first half of the dyeing may be expressed as:

$$\frac{t}{t_{\frac{1}{2}}} = \left(\frac{\alpha}{.5}\right)^n$$

where, according to theory, n=2. Plotting the logarithm of each side of the equation, in Figure 9, shows that iso-hydric fiber dyeings have the theoretical value of n=2 whereas iso-molar solution dyeings using a monovalent acid have a value of n=1.0 and with a divalent acid a value of n=1.5

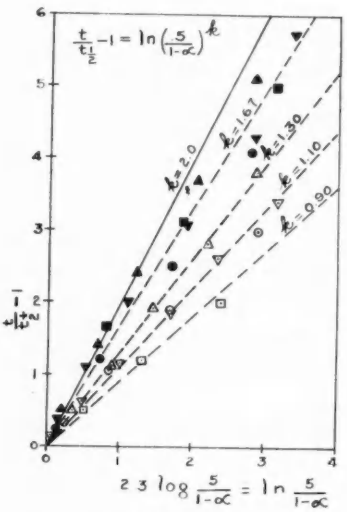

Figure 10
Comparison of iso-molar and iso-hydric, last half
Symbols as in Figure 8

Similarly the theoretical relationship for the last half of the dyeing may be expressed as:

$$\frac{t}{t_{\frac{1}{2}}} - 1 = \ln\left(\frac{.5}{1-\alpha}\right)^k$$

where, according to theory, k=2. Figure 10 shows that for iso-hydric fibers the theoretical k=2 fits fairly well although k=1.67 fits better for the whole range. For the iso-molar dyeings a value of k=1.10 best fits the cases where (y—z)=0; a value of k=.90 fits the case where (y—z) = —1; and a value of k=1.30 fits the case where (y—z) = +1.

SUMMARY

1) Dyeing data of known accuracy obtained under three sets of conditions, and suitable for testing the effect of acid and dye anion valence on dyeing rate, have been presented.

2) A semi-empirical determination of the nature of the dye concentration gradient in the fiber has been made and it has been shown that the time of half-dyeing is a parameter of dyeing rate of theoretical as well as practical importance.

3) A mathematical derivation has been made of a relationship which expresses dyeing rate reasonably well in the case of dyeing fibers which are already at equilibrium with the acid, and where consequently dye diffusion is not complicated by simultaneous acid diffusion.

4) This basic relationship may also be applied to iso-molar dyebath dyeings by a change in certain figures in the relationship. These changes in figures are a function primarily of the acid anion valence and secondarily of the dye anion valence.

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May 5, 1958

Report of AATCC Committee on Nuclear Radiation———

ESTABLISHING A RADIOCHEMICAL LABORATORY

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This paper discusses the general requirements for developing a small radiochemical laboratory suitable for investigative and analytical applications of radioactivity to textile problems. The following basic requirements are considered:

1) **Training of Personnel**
2) **Atomic Energy Commission Regulatory Procedures**
3) **Laboratory Design and Facilities**
4) **Radiation Safeguards**
5) **Radioactivity Measurement Instrumentation.**

Approximate costs involved are indicated. A bibliography is included which lists reference books on radioactivity, review articles on applications of radioisotopes in the textile industry, and pertinent Atomic Energy Commission and Bureau of Standards publications on handling and use of radioactive materials.

INTRODUCTION

THE purpose of this paper is to discuss the basic requirements for establishment and operation of a radiochemical laboratory for investigative and analytical purposes. No effort is made in this article to present information on the nature of radioactivity *(1-3)* or details on specific applications to textile problems, as several publications have recently reported on these topics *(4-12)*.

Our considerations will be confined to the establishment of a radiochemical facility which might perform the following types of laboratory studies:

Durability testing of finishing agents
Detergency testing
Mechanism studies in polymerization, adsorption, dyeing, and diffusion
Studies on fiber movement during drafting
Evaluation of irradiated fibers
Analytical applications by isotope dilution.

Investigative laboratory applications should not be confused with *plant* use of *encapsulated* radiation sources in thickness gauges or static eliminators (which require no special isotope training or handling equipment) or with the uncharted field of plant process control through use of short-lived radioisotopes (which would require special training and techniques). Facilities required for these applications will not be considered in this paper nor will the special problems associated with the use of high-intensity sources for studies on the effects of radiation on fibers. It should be pointed out that it is possible for groups to conduct investigations on radiation-induced effects without installing a high-intensity source by having irradiations performed at University or AEC facilities and then evaluating fiber characteristics in their laboratory upon return of the sample.

GENERAL REQUIREMENTS FOR ESTABLISHING A RADIOCHEMICAL LABORATORY

The general requirements which must be considered in the development of a radiochemical laboratory can be categorized as follows:

1) Training of Personnel
2) Atomic Energy Commission Regulatory Procedures
3) Laboratory Design and Facilities
4) Radiation Safeguards
5) Radioactivity Measurement Instrumentation

TRAINING OF PERSONNEL ———Before the establishment of a radiochemical facility is undertaken, it is, of course, necessary that personnel be available who are trained in the techniques of handling and measurement of radioactive materials. To provide individuals with this specialized instruction, several universities, commercial companies, and the Oak Ridge Institute of Nuclear Studies offer short courses in radioisotope techniques. Tuition fees for such courses are about $100-200 per individual. Only one person need be trained in such a course to institute a radioisotope program. This individual can, in turn, train personnel in his own laboratory. In the future, an increasingly large number of trained personnel will be available since many universities are incorporating courses in nuclear technology in their formal curricula.

ATOMIC ENERGY COMMISSION REGULATORY PROCEDURES ———About seventy different radioisotopes can be obtained in small quantities without the necessity of applying for a license from the Atomic Energy Commission for their purchase. The isotopes and the license-exempt quantities are indicated in Title 10, Part 20, Code of the Federal Register. These quantities of radioisotopes can be obtained in a variety of chemical compounds particularly if the isotope is incorporated into organic compounds. For example, 50 microcuries of C-14 and 250 microcuries of H-3 of a labeled compound can be obtained in this manner. The amounts of activity that are available are sufficient to perform several limited types of studies.

In order to obtain quantities greater than those specified as license-exempt, a USAEC Form 313 entitled "Application for By-Product Material License" must be submitted to the Division of Licensing and Regulation for approval. Information requested on the form includes applicant's experience, equipment and facilities for handling isotopes, available radiation monitoring instrumentation, radiological safety procedures, quantity and type radioisotope requested, and the proposed use of the radioactivity.

Review of the application is then made by the AEC and if it is concluded that proper radiological health-safety procedures and equipment will be applied by qualified personnel, the license is granted.

*Member of the AATCC Committee on Nuclear Radiation.

Detailed information on applying for license for purchase of radioisotopes can be obtained from the

U S Atomic Energy Commission
Division of Civilian Application
Isotopes Extension
1717 H Street, NW
Washington, DC.

LABORATORY DESIGN AND FACILITIES——Several excellent articles *(13-17)* have been published which describe in considerable detail all aspects of radioisotope laboratory design and operation. This discussion will be concerned only with the main aspects of laboratory design, chemical hood requirements, plumbing, and radioactive waste disposal.

The radioactivity laboratory should be restricted to individuals involved with work in that area and should be separated by suitable enclosures from the other laboratories. In general, laboratories utilized in radioisotope work are similar to conventional chemical laboratories. The extent to which ordinary laboratory design has to be modified depends primarily on the type of emitters being employed (ie, weakly penetrating beta emitters or the much more penetrating gamma emitters), the level of radioactivity anticipated, the numbers of people involved, and the nature of manipulations.

In handling penetrating gamma emitters, remote handling tongs and shielding are required, but for applications involving weak beta emitters no special handling equipment or shielding is necessary.

Chemical manipulations on radioactive materials should be conducted in a hood. Ordinary chemical hoods can be employed if a velocity of 75-150 linear feet per minute is maintained across the face. Radioisotope hoods which are commercially available ($1500-2000) can be operated at a lower linear velocity of 50-100 linear feet per minute due to special design features. Before use of hoods, air-flow characteristics should be carefully measured with a velometer. The inside of hoods and work surfaces should be of a nonporous material and covered with strippable paint for easy decontamination.

No special plumbing is required. In cases where small amounts of radioactivity are employed, waste effluents may be introduced into ordinary sewerage systems if they are sufficiently diluted to conform with Federal *(18)* and state regulations. This procedure of disposal should, of course, be followed only after it has been established that the level of activity in the effluent complies with the regulations.

In other cases, the radioactive wastes should not be introduced into sewerage systems but placed in special metal containers. Arrangements for disposal of these containers can be made with several commercial organizations or with the Oak Ridge National Laboratory.

Textile-laboratory test apparatus, such as laboratory padders and laundry equipment, can be used for tracer studies as long as all such work is conducted under controlled conditions by an individual trained in radioisotope techniques. The decision as to whether such laboratory padder and laundry equipment can be used interchangeably for radioisotope studies and nonradioactive work depends upon how much activity is retained in the equipment after use and decontamination. This, in turn, depends upon the level of activity employed, the isotope used and its half-life, and the effectiveness of removal of activity from the equipment. Therefore, no general rule can be established, but each case must be separately considered, taking into full account regulations on permissible concentrations of activity.

RADIATION SAFEGUARDS——As a result of the extensive experience of the AEC and of many research laboratories in handling radioisotopes, proven techniques and standards have been developed to insure radiological safety of personnel *(18-24)*.

The basic radiation protection procedures of a radiochemical laboratory consist of strict control of the radioactive material and routine use of radiation-detection devices; viz, film badges, pocket dosimeters, a laboratory monitor, and survey instrumentation. The film badge is an indirect reading personnel monitoring device wherein the extent of the darkening of the film by radiation is a measure of exposure. It is an extremely sensitive technique and offers the great advantage of providing a permanent record of individual accumulated radiation dosage. Each film badge is worn for a period of one to two weeks and then is replaced by a new badge. Film badge service is available at approximately $.65 per badge from several commercial sources.

Pocket dosimeters (approximately $40) may be either direct or indirect reading and are used to check exposure during a single day or after a specific operation.

A laboratory monitor (approximately $350) is a Geiger-tube device which measures counting rate and is employed to check decontamination of glassware, equipment, or working areas.

Survey instruments (approximately $300) are quantitative devices consisting of a Geiger-Mueller tube or an ionization chamber as the primary detector and are used for scanning surfaces, work areas, and storage areas. Geiger-Mueller tube survey meters (sometimes called beta-gamma instruments) are more sensitive than ionization-chamber-type instruments (sometimes called "Cutie Pie") but also have more limited range.

The basic requirements for radiation protection devices in a small radiochemical laboratory performing tracer experiments at microcurie levels would be fulfilled with acquisition of a film badge for each individual who enters the restricted area, a few pocket dosimeters, and a laboratory monitor which could also be used as a survey instrument.

When handling millicurie levels of activity, particularly gamma emitters, a GM tube survey meter or a "Cutie Pie" is required.

RADIOACTIVITY MEASUREMENT INSTRUMENTATION——A great variety of nuclear measurement instrumentation is now available from many commercial sources. The choice of radioactivity-counting instruments depends primarily on the radioisotopes that will be employed, the precision required in the measurements, and the amount of work anticipated. An excellent review of all types of nuclear radiation measurement techniques including a comprehensive list of references is available *(25)*.

A basic laboratory setup consists of a radiation detector, a shield for the detector, a pre-amplifier and amplifier, and a scaler. The radiation detector converts the radiation to an electrical pulse, which is then amplified and led into the scaler. A scaler may be considered to be a computer which totalizes the number of pulses led into it over a given period of time. The total number of pulses divided by the time gives the counting rate of the sample in counts/time. To convert this number to absolute units of disintegrations/time, which are needed for calculations, the counting setup is calibrated with standard radioactive sources.

Several different types of radiation detectors have been developed and are widely available commercially;

(*Concluded on Page P309*)

36th Annual Convention———

WET-SOILING STUDIES ON RESIN-TREATED COTTON FABRICS*

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The complaint has been made by a number of observers that some resin-treated textiles are highly susceptible to wet-soiling during laundering. In the course of research on "wash-and-wear" cottons, the tendency toward wet soiling has been studied. Conditions under which wet-soiling occurs have been determined and various components of a number of commercial resin formulations have been examined to determine causes of soiling. A simple laboratory test for wet-soiling has been adopted using a Launder-Ometer with soap solution as the detergent and carbon black as the soiling agent under conditions approximating those encountered in commercial laundering. The effect of variables on soiling has been determined. Causes of soiling are outlined and the effects illustrated with photographs, electron micrographs, tables and graphs.

INTRODUCTION

THE complaint has been made by a number of observers that some resin-treated cottons become soiled during laundering. In studies at this Laboratory (*8*, *9*) on the effect of commercial and home laundering conditions on cotton treated with dimethylol cyclic ethyleneurea (referred to as CEU, but more correctly 1,3 bis (hydroxymethyl)-2-imidazolidinone), an acrylate thermoplast, and a silicone, similar results were observed. It was noticed that wet-soiling occurred mainly under conditions used by commercial launderies in the laundering of shirts. In preliminary wet-soiling studies it was observed that this soiling was most pronounced under laundering conditions of high temperature, high ratio of cloth to water, and laundry water which was quite dirty. Bleaching and solvent extraction had little effect on cleaning these fabrics.

From these results it was concluded that in all probability an insoluble soil was attached to the fiber in some way. Examination of an electron micrograph (Figure 1) supported this conclusion. In the normal cotton fiber, soil particles line up in the natural rugosities of the fiber (*2*); whereas, in these samples, the particles were irregularly distributed in a coating layer which itself had filled up the crevices in the fiber. The present study was undertaken with the object of determining the cause and extent of wet soiling of resin-treated cotton fabrics and developing a method of measuring this effect as a tool for screening new formulations for resistance toward soiling.

MATERIALS AND METHODS

An 80 x 80 white cotton print cloth (3.2 oz/sq yd), which had been boiled, bleached and desized, was used in this investigation. The CEU-acrylate-silicone finish was the one which received the major emphasis in this study (*10*). This finish was applied by treating the print cloth with an emulsion prepared from 14 g of a 50% solution of dimethylol cyclic ethyleneurea (Rhonite R-1[1]), 5 g of a 35% solids emulsion of an acrylate thermoplast (Rhoplex S-1), 1.5 g of a 35% solution of a modified zinc salt catalyst (Catalyst H-7), 2 g of a 40% solids emulsion of a silicone resin

[1] The mention of trade names and firms does not imply their endorsement by the Department of Agriculture over similar products or firms not mentioned.

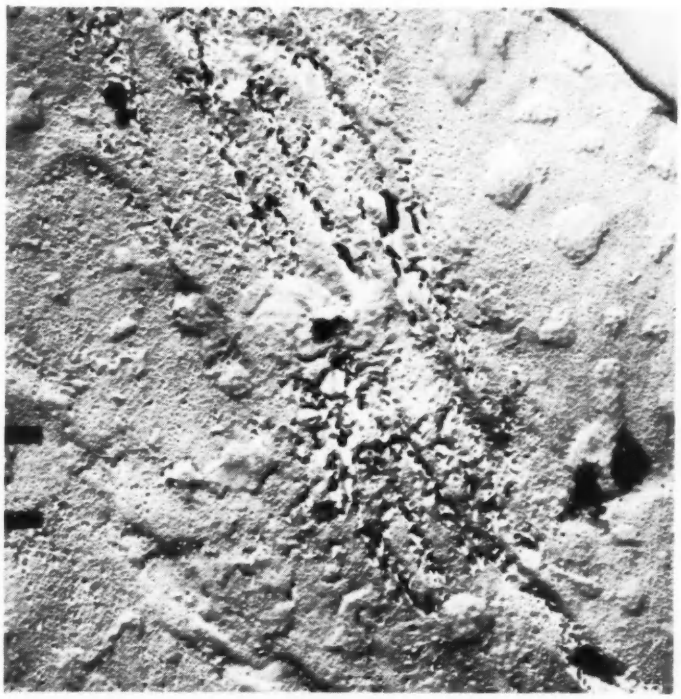

Figure 1

Electron micrograph showing soil particles on the surface of a cotton fiber with the CEU-acrylate-silicone finish. Magnification is indicated by the distance between the marginal marks which is 10,000 Å or 1 μ.

*Presented during the 36th Annual AATCC Convention on November 16, 1957 at the Hotel Statler, Boston, Mass.

(De Cetex 104 emulsion), 0.4 g of catalyst for the silicone resin (Catalyst XEY-21), 0.1 g of a softening agent (Triton X-155)), and 77 g of water. The emulsion was padded onto the cloth to a 70-80% wet add-on and cured from the wet state by ironing with an ordinary electric hand iron at the setting for cotton (ca 200°C). In addition, cloth samples were prepared which were finished with the individual components—CEU, acrylate, and silicone—at add-ons comparable to their percentage of the total finish from the complete emulsion.

Other resin finishes investigated were methylolmelamine (Resloom HP) and methylolacetylenediurea (Resipon AD), both applied with an alkanolamine hydrochloride catalyst (Catalyst AC); and methylated methylolmelamine (Aerotex M3) and a modified methylolmelamine (Aerotex MW), both applied with a magnesium salt catalyst (Aerotex Accelerator MX). These resins were padded onto print cloth, dried on pin frames at 60°C for 7 minutes and cured at 160°C for 4 minutes in mechanical convection ovens.

In the laboratory soiling test, carbon black with a particle size of 220 Å (Monarch 81) was used as the soiling agent. A total of seven swatches of cloth, 4″ x 4″, always including an untreated control and a sample with the CEU-acrylate-silicone finish, were soiled simultaneously in a Launder-Ometer can. The tests were run in quadruplicate. Ten mg of carbon black, 0.5 g of yellow soap (*12*), and 0.1 g of anhydrous sodium carbonate in 250 ml of water with 100 stainless steel balls, ¼ inch in diameter, were preheated to 180°F in the stainless-steel cans. The cloth samples were inserted and the Launder-Ometer run at this temperature for 7 minutes. Swatches were then rinsed free of soap with agitation and ironed dry. These conditions were adopted after a study of the variables, as described below.

Degree of soiling was determined from readings of reflectance on a Hunter Reflectometer. The "K/S value" was calculated from the reflectance reading using the Kubelka-Munk equation (*5, 6*):

$$K/S = \frac{(1-R)^2}{2R}$$

where R is the observed reflectance, K is the coefficient of reflectivity, and S is the coefficient of light scattering.

TABLE I

Comparison of the effect of detergents in the wet soiling of resin-treated fabrics

Detergent used in soiling solution[1]	K/S: Untreated cotton	CEU-treated	Acrylate-treated	Silicone-treated	CEU-acrylate-silicone
None[2]	0.100	0.162	0.641	0.761	0.798
Yellow soap[3]					
0.25 g	0.040	0.084	0.428	0.562	0.736
0.35 g	0.055	0.035	0.345	0.205	0.444
0.50 g	0.032	0.014	0.294	0.141	0.243
0.75 g	0.025	0.010	0.278	0.116	0.243
Built detergent[4]					
0.1 g	0.062	0.077	0.686	0.829	0.779
0.25 g	0.036	0.025	0.457	0.522	0.406
0.35 g	0.033	0.019	0.349	0.845	0.264
0.50 g	0.030	0.019	0.286	0.707	0.200
Unbuilt detergent[5]					
0.16 g	0.069	0.029	0.414	0.387	0.297

[1]Solution of 250 ml of water containing 10 mg carbon and the detergent indicated. Test run at 180°F for seven minutes.
[2]No detergent used; soiled with carbon black in water.
[3]Federal Specification #P-S-566b. To the soap solution was also added 0.1 g sodium carbonate except for the 0.75 g soap solution, which contained 0.2 g sodium carbonate.
[4]Tide.
[5]Igepon T (sodium (β-oleamido) ethylsulfonate).

DISCUSSION

SELECTION OF CONDITIONS FOR TESTING———The conditions detailed above were selected after consideration of a number of factors as follows. In general, conditions were used which approximated those encountered in commercial laundering so as to obtain a wet-soiling test which would give practical results.

In their comprehensive work on the "Technology and Theory of Drycleaning," Martin and Fulton (*7*) state that carbon is the main ingredient of insoluble and non-emulsifiable soils. Accordingly, a carbon black was chosen as the soiling agent. For convenience in laundering a number of small cotton swatches simultaneously, at controlled temperatures, the Launder-Ometer was used in the present study. Steel balls were used to simulate the abrasion encountered in commercial laundering of our resin-treated cloth (*8*) where the samples were washed with 300 pounds of shirts in a minimum of water. The Launder-Ometer has been used for both wet and dry soiling of fabric, by Utermohlen and coworkers (*13*). However, their aqueous wet-soiling studies were performed by presoiling with concentrated aqueous dispersions rather than from dilute detergent solutions as used in the present work.

The reflectometer was the best tool available for determining quantitatively the soiling of the fabric. Martin and Fulton, in their discussion of methods of measuring soiling (*7*), point out that degree of soiling may be defined as either the amount of soil on the fabric, or in terms of the appearance of the fabric. Fortunately, both soiling and loss of original brightness may be obtained from the reflectance values by relationship K/S, mentioned above and based on the theory of Kubelka and Munk (*5, 6*).

A laundering time of 7 minutes, a temperature of 180°F, and yellow soap and sodium carbonate as a detergent were all selected for preliminary work because these conditions are often encountered in commercial laundering. However, the effect of changes in these variables was also investigated. The amount of carbon added was varied from 0-20 mg/250 ml of solution. The 10-mg amount was selected because it gave a good range of reading in the reflectometer. Soiling increased as the amount of carbon increased but the larger amounts gave extremely low reflectance values, and with the smaller amounts of carbon, soiling was not sensitive to changes in the laundering conditions.

When the effect of temperature was studied, using a range of 80° -200° F, resin-treated cloth samples became progressively more soiled with increased temperature. When time of laundering was varied from 2-35 minutes, at a temperature of 180°F, soiling increased with a diminution of rate after about 15 minutes. There was no satisfactory endpoint and 7 minutes was chosen to conform with commercial practice mentioned above.

To determine whether another type of detergent would be more effective in preventing deposition of soil, different concentrations of yellow soap with sodium carbonate, an unbuilt detergent, Igepon T [sodium (β-oleamido) ethylsulfonate], and a built detergent (Tide) were used with the carbon in the soiling test. From the results given in Table I, it can be seen that the acrylate and silicone components were responsible for the tendency to become soiled. It appeared that, in general, the yellow soap at 0.50 g/250 ml concentration

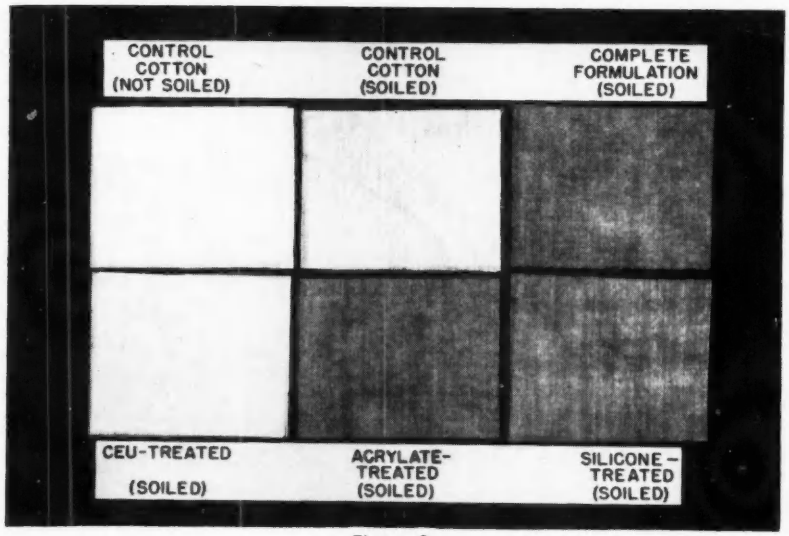

Figure 2

Soiling of cotton treated with the complete resin formulation and its components as compared to untreated control.

was satisfactory, and since this material has a reasonably constant composition (*12*) and is used in many laundries, it was selected as detergent, in this concentration, for further use in the soiling studies.

CAUSES OF SOILING OF RESIN-TREATED COTTON ——— Cloth swatches were resin treated with the complete emulsion formulation mentioned above and with each of the three components, CEU, acrylate and silicone by themselves. When these four samples with an untreated control were wet-soiled, the cotton control and the cotton with CEU resin alone were practically unchanged. However, the silicone and acrylate samples had picked up a considerable amount of carbon black. In Figure 2 are pictured the results of this test. It was concluded that the acrylate and silicone materials, which are almost entirely on the surface of the fiber, were probably softening and becoming tacky at the laundering temperatures so that the carbon particles adhered to the tacky surface.

Examination of the properties of the film formed when the acrylate thermoplast was cast on a glass surface substantiated this conclusion. The film was soft and tacky even at room temperature. On shaking the film with a dispersion of carbon black, it was found that the particles impinged upon the surface and were stuck fast. In attempting to wash the surface, it was found that the particles were imbedded more deeply into the plastic film. Using hot water, it was found that the film softened more and the particles were driven even more readily into the polymeric material. Thus, it appears as though the soiling of this type of thermoplast is essentially irreversible.

Attempts were made to find a good method of cleaning the soiled samples. Calgonite, a mixture of alkaline sodium silicate and sodium polyphosphates (*3*), has been recommended for the "reconditioning" of soiled Dacron and Dacron-cotton garments. This was tried and, although it was noticeably effective in cleaning the slightly soiled cotton control samples, as well as those treated with CEU alone, the method did not give an acceptable product with the other samples.

Drycleaning, by a standard method (*1*), also failed to improve the appearance of samples which contained acrylate. For example, samples of CEU-acrylate-silicone and acrylate-treated cotton which had been soiled to K/S values of 0.436 and 0.326, respectively, were changed to values of 0.419 and 0.324 by the drycleaning process. Obviously, such small improvements do not yield usable products.

The sodium salt of carboxymethylcellulose (CMC) has been used both as an additive on cotton to prevent soiling (*4, 11*) and in detergent solutions to prevent redeposition of soil. The use of 0.1% CMC add-on as an after treatment to the resin-treated fabric and the addition of 0.1% CMC to the soiling solution produced samples with comparable soiling. The K/S values of these samples were about one-third less (0.196) than without the CMC (0.297).

RECYCLING OF SOILED RESIN-TREATED FABRICS———To demonstrate the effect of repeated soiling, the five types of samples previously described were subjected to 5 cycles of soiling with determination of reflectance after each cycle. The experiment was run at two different temperatures, 120°F and 180°F. The former approximates the temperature of home laundering, the latter, that of commercial laundering. The results are shown graphically in Figure 3. It is readily seen that the higher temperature produces much more serious damage by soiling. The untreated cotton and that treated with CEU resin alone soiled very little more on repeated treatments. However, the acrylate and silicone components soil progressively on repeated exposure to the soil bath. The contribution of these two components to the soiling of the total resin treatment is evident from the figure. These finishes continue to pick up carbon particles at a rapid rate on repeated soiling with no evidence of a "soil saturation"—the curves seem to rise with no break in rate.

In order to determine the effect of repeated laundering after soiling, the five types of samples were first soiled as usual and then laundered together in the Launder-Ometer using the same conditions except that no carbon was added in the laundering. Results are illustrated in Figure 4 for the set run at 180°F. The untreated cotton cloth and the CEU-treated sample were only slightly soiled and lost most of this during the subsequent laundering. The silicone-treated sample also lost a small amount of soil during laundering. However, the cotton cloth treated with the CEU-acrylate-silicone formulation and the cloth treated with acrylate alone became more soiled during subsequent laundering. Apparently, the latter samples picked up the soil lost by the first three samples, or perhaps the carbon became more evenly distributed on the surface of the cloth so as to decrease the reflectance values. Similar results were obtained when run at 120°F except that the samples were soiled to a lesser degree.

SOILING OF COTTON TREATED WITH VARIOUS CREASEPROOFING RESINS———The work described shows that the wet-soiling of CEU-acrylate-silicone resin-treated cotton is due almost exclusively to the thermoplastic materials and not to the CEU resin itself. A number of other representative methylol resins used commercially to make cotton

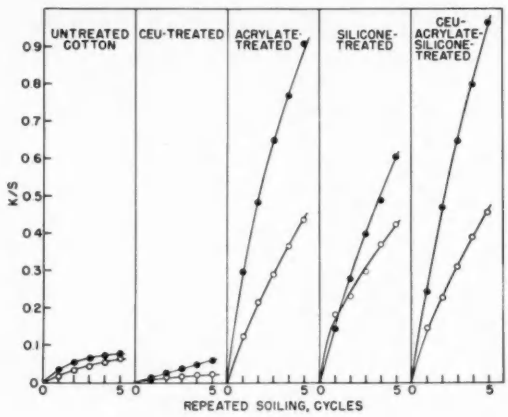

Figure 3
Repeated soiling of cotton treated with the complete resin formulation and its components as compared to untreated control at 180°F (●) and 120°F (○).

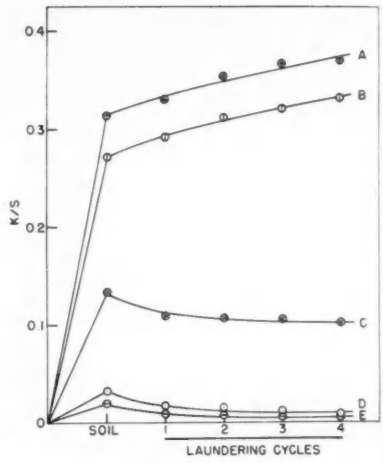

Figure 4
Repeated laundering after soiling of cotton treated with the complete resin formulation (A) and its components, acrylate (B), silicone (C), and CEU (E), as compared to untreated control (D).

wrinkle-resistant were investigated. In Table II are shown the results obtained when 4 other resins were used without thermoplastic additives. The untreated cotton, the CEU-treated sample and the CEU-acrylate-silicone sample are included for comparison. It may be noted from the percent reflectance and K/S values, that, without exception, the 5 fabrics treated with methylol-type resins alone are slightly more resistant toward wet-soiling than the untreated cotton itself.

TABLE II
Comparison of the wet soiling of fabric treated with various commercial resins

Treatment[1]	% Resin Add-On	% Reflectance	K/S Value
Untreated control	—	76.7	0.029
Methylolmelamine	6.0	78.7	0.023
Modified methylolmelamine	3.7	80.8	0.017
Methylated methylolmelamine	4.3	81.7	0.015
Methylolacetylenediurea	3.5	79.8	0.019
CEU	3.9	80.3	0.018
CEU-acrylate-silicone	5.6	50.3	0.243

[1] See Section, Materials and Methods.

SUMMARY AND CONCLUSIONS

Cotton cloth treated with a CEU-acrylate-silicone finish has been found to be subject to wet soiling, especially under conditions such as are encountered in commercial laundering. Once soiled, the CEU-acrylate-silicone finished cotton cannot be cleaned—the soiling is irreversible. CMC will decrease the amount of soiling slightly, but not sufficiently for good reconditioning. Drycleaning is likewise ineffective.

The chief causes of the soiling are the soft, tacky films of acrylate and silicone which are deposited on the surface of the fibers. The CEU resin does not contribute to such wet soiling. In fact, cotton fabrics treated with commercial methylol resins, without additives have been found to be more resistant to wet soiling than untreated control fabrics.

A simple laboratory test for wet soiling has been adopted. Cloth swatches are soiled in a Launder-Ometer with a soap solution containing a small amount of carbon under controlled conditions. A quantitative estimation of the extent of soiling is obtained, using a reflectometer.

In this test, the variables—time, temperature, and concentration of carbon—affect the degree of soiling. Synthetic detergent, in place of soap, has little effect on soiling.

ACKNOWLEDGMENT

The authors wish to thank Verne W Tripp and Anna T Moore for preparing the electron micrograph, and George I Pittman for preparing the figures.

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36th Annual Convention and Metropolitan Section———

EVALUATION OF CARRIERS FOR DACRON DYEING*

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Carriers are widely used in the dyeing of Dacron and other polyester fibers. A simple procedure is presented which will allow for a comparative evaluation of two or more carriers. First, carriers to be investigated are screened as to toxicity, effect on other fibers, and application procedure. Next, evaluation dyeings are made. A certain shade is obtained with a given carrier and dyestuff combination. This shade is matched with another carrier and varying amounts of the same dyestuff combination. The combined cost of carrier and dyestuff is then calculated for both dyeings. The difference provides a measurement of the effectiveness of the carriers to be investigated, provided that the dyeings have acceptable appearance and fastness properties.

A tentative method to determine the optimum amount of carrier for a given dyestuff combination is also described.

INTRODUCTION

POLYESTER fibers such as Dacron and Terylene, are easily dyed with disperse dyes provided that dyeing temperatures are 250° F or higher. Such temperatures require pressurized equipment which is not generally available, above all, where piece goods are concerned. High-temperature dyeing has both advantages and drawbacks (*1*), but it is definitely limited by the nature of other fibers that may be present—wool, for instance, should not be exposed to temperatures in excess of 230° F. By the use of certain chemicals known as carriers, the amount of dye absorbed at 205-208° F is increased to nearly that absorbed at 250° F (*2*). Temperatures of 205-208° F are attained in many kinds of nonpressurized equipment. Carrier dyeing of polyester fibers has therefore become generally acceptable.

A number of chemicals are useful as carriers. In addition, a great many proprietary products are offered to the industry. It is our purpose to present a method that will allow a comparative evaluation of two or more carriers and to illustrate it with some examples, without, however, attempting to evaluate the numerous products on the market.

PRELIMINARY SCREENING

TOXICITY——In most cases either the literature or the manufacturer will provide the necessary information. It should be noted that many carriers steam distill under the usual conditions of application. Therefore, a toxic material that has a high boiling point may be as dangerous as a low boiling one. Most of the carriers presently available cannot be considered completely nontoxic, and a good ventilating system is necessary for all carrier dyeing. Toxicity alone can be sufficient cause to eliminate a carrier from further consideration.

EFFECT ON OTHER FIBERS PRESENT———Very often Dacron is blended with other fibers. Carriers may have a detrimental effect on these fibers. Certain phenolic carriers, for instance, degrade rayon acetate and therefore should not be used on Dacron and acetate blends. A useful indication is obtained by comparing the tensile strengths of goods kept at 205°F for three hours in water, and in a 10 g/l carrier solution.

APPLICATION PROCEDURE——A carrier should be no more difficult to apply than the dyestuff with which it is used. Dyeing time is extremely costly. If carrier application time materially adds to dyeing time, the added cost should be considered in the overall evaluation. If the application of a carrier requires control operations that can be performed only by laboratory or supervisory personnel, its usefulness will be limited to a very few dyehouses.

CARRIER EVALUATION DYEINGS

GENERAL———After a carrier passes preliminary screening its most important properties are determined by making a number of dyeings with it. An acceptable dyeing has an even, uniform, and clear appearance. A carrier that produces spotty or uneven dyeings is not usable. An acceptable dyeing also has the required fastness to washing, crocking, light, drycleaning, etc. These are essentially the properties of dyestuffs, but a carrier can affect them detrimentally. If a carrier does not give the required fastness properties it must be eliminated from further consideration. This leaves essentially only one variable, namely the combined cost of carrier and dyestuff needed to obtain an acceptable dyeing of a given shade. Carriers, then, are suitably evaluated by preparing matching dyeings made under optimum conditions of carrier concentration and then comparing the costs of the matching dyeings.

A carrier Y standard shade is obtained on 100 pounds of Dacron as follows:

Carrier Y	— 10 pounds @ $ .50	— $ 5.00
Dyestuffs	— 5 pounds @ 4.00	— 20.00
Total cost of dyeing		$25.00

The dyeing below, made with carrier Z, shows considerably better color value, at the same cost:

Carrier Z	— 10 pounds @ $ .50	— $ 5.00
Dyestuffs	— 5 pounds @ 4.00	— 20.00
Total cost of dyeing		$25.00

The appearance and fastness properties of both dyeings are acceptable.

The difference in color can now be determined in various ways (*3*), but a much more practical and final measurement of the difference is obtained by matching the carrier Y shade in subsequent dyeings. This is done by reducing the amount of either carrier Z or of dyestuff. From a purely economical point of view it would be unwise not to exhaust all the expensive dyestuff that carrier Z evidently can handle. Practically, it is found that significant, say 20 percent, differences in color value cannot usually be matched by varying carrier concentration, for the following reasons: a certain minimum of carrier must be used to obtain the required fastness results, excessive amounts of carrier actually decrease color values, and color value differences between the two extremes are small. A tentative method that indicates the optimum carrier con-

*Presented November 16, 1957 before the 36th Annual AATCC Convention at the Hotel Statler, Boston, Mass, and April 18, 1958 before the Metropolitan Section at Kohler's Swiss Chalet, Rochelle Park, N J.

centration for a given shade is described below. For the comparative evaluation of carriers it is quite satisfactory to use carrier concentrations as recommended by the manufacturer.

PLANT PROCEDURE ——— Carrier A is presently used in production to dye a certain heavy shade on 100 pounds of Dacron goods as follows:

Carrier A	— 14 pounds @ $ .40	—	$ 5.60
Dyestuffs	— 6 pounds @ 4.00	—	24.00
Total carrier A dyeing cost			$29.60

Carrier B has passed preliminary screening. It is offered at $.50 per pound and the supplier recommends that 14 pounds of carrier B be used to dye a heavy shade on 100 pounds of Dacron goods. A simple beaker dyeing made with 14 percent carrier B and 6 percent of the same dyestuffs showed acceptable appearance and fastness properties as well as a heavier shade. The extent of the difference in color value is determined in the plant evaluation dyeing. The usual amount of dyestuff is arbitrarily reduced by 30 percent, and the dyeing accordingly is started with 4.2 pounds of dyestuff. After one hour at dyeing temperature the first add is made, followed by others, until the shade obtained in the carrier A dyeing is matched. If carrier B gives considerably better color value, the match may have been made as follows:

Carrier B	— 14 pounds @ $ .50	—	$ 7.00
Dyestuffs	— 4.5 pounds @ 4.00	—	18.00
Total carrier B dyeing cost			$25.00

If the dyeing meets appearance and fastness requirements, carrier B, even though it costs 25 percent more than carrier A, is indeed a better carrier.

The great advantage of plant evaluation dyeings is that they can be made in plant equipment and under actual production conditions. This is also their shortcoming, because in production, the dyeing is terminated when the match is made, and for this reason time and temperature conditions are rarely the same for any two dyeings. On the beck, for instance, it is quite possible to dye matching shades that vary as much as 7.5 percent from the standard dyestuff formulation. It should be noted that the plant procedure takes the volatility of the carrier into account. A match cannot be made economically, or even made at all, if a considerable amount of carrier is lost rapidly.

Three specific evaluation dyeings will be described to illustrate the plant procedure. A modified phenol derivative carrier, Carolid, was to be evaluated against a modified solvent carrier, Tanavol. The latter has been used in production for a considerable length of time. A rate of 14 percent, based on the weight of the Dacron present, has been found to give heavy dyeings of acceptable appearance and fastness properties. The same percentage of the higher-priced modified phenol derivative carrier is recommended, which will increase carrier costs considerably. On the other hand, beaker dyeings made with equal amounts of dyestuff show that the more expensive carrier gives heavier shades.

The goods to be dyed on the beck were ten-piece lots of 50 percent spun Dacron—50 percent viscose tropical, weighing about 8½ ounces to the yard. The same six-foot beck was used for all dyeings. The liquor to goods ratio was about 17:1. First, a standard dyeing was made using Tanavol at the usual concentration. Next, an evaluation dyeing mas made in which the same shade was matched, using Carolid at the recommended concentration, varying only the amounts of dyestuff used. The dyes mentioned are those that happened to be used in the plant where the evaluation dyeings were made. They could have been replaced by others of equivalent properties. Mention of certain disperse dyes does not imply a preference or a recommendation. Carrier evaluation dyeings can be made with any disperse dye, the particular brand used being of no significance in this respect. Table I gives all the details of the following dyeings.

TABLE I

Plant Match 2—Navy

	@ $	Per 100 lbs Dacron lbs	Cost $
Standard dyeing			
Latyl Blue BG	7.67	1.000	7.67
Latyl Violet BN	2.18	5.150	11.23
Latyl Cerise B	5.03	0.470	2.36
Acetamine Yellow 4RL	3.14	0.420	1.32
Total dyestuff	3.21	7.04	22.58
Tanavol	.47	14.0	6.58
Total dyeing cost			29.15
Evaluation dyeing			
70% of standard dyeing total dyestuff above	3.21	4.928	15.81
Latyl Violet BN	2.18	.180	.39
Total dyestuff		5.108	16.20
Carolid	.59	14.0	8.26
Total dyeing cost			24.46
Savings against standard dyeing			4.69

Plant Match 4—Brown

	@ $	Per 100 lbs Dacron lbs	Cost $
Standard dyeing			
Latyl Blue BG	7.67	1.332	10.22
Latyl Violet BN	2.18	1.370	2.99
Latyl Cerise B	5.03	1.505	7.57
Acetamine Yellow 4RL	3.14	1.900	5.97
Total dyestuff	4.38	6.107	26.75
Tanavol	.47	14.0	6.58
Total dyeing cost			33.33
Evaluation dyeing			
70% of standard dyeing total dyestuff above	4.38	4.275	18.72
Latyl Violet BN	2.18	.20	.44
Latyl Cerise B	5.03	.155	.78
Total dyestuff		4.630	19.94
Carolid	.59	14.0	8.26
Total dyeing cost			28.20
Savings against standard dyeing			5.13

Plant Match 6—Gray

	@ $	Per 100 lbs Dacron lbs	Cost $
Standard dyeing			
Interchem Blue GFS	3.28	1.170	3.84
Interchem Yellow G	2.08	.225	.47
Interchem Black NCS	2.61	3.370	8.80
Interchem Pink BLF	3.53	.375	1.32
Total dyestuff	2.81	5.140	14.43
Tanavol	.47	14.0	6.58
Total dyeing cost			21.01
Evaluation dyeing			
70% of standard dyeing total dyestuff above	2.81	3.600	10.12
Interchem Pink BLF	3.53	.038	.13
Total dyestuff		3.638	10.25
Carolid	.59	14.0	8.26
Total dyeing cost			18.51
Savings against standard dyeing			2.50

Plant Match 2. In the standard dyeing using Tanavol, a navy was dyed to the specified shade. The match was made after two adds of dyestuff. In the evaluation dyeing on the next day, Carolid was used. The dyeing was started with 70 percent of the total dyestuff used in the standard dyeing. No add was made after one hour at the boil. After two hours, an add of Latyl Violet BN was made, and after another hour the dyeing was considered matched. The shade was a little light, but seemed to be clearer. The evaluation dyeing showed a saving of $4.69 per 100 pounds Dacron, which amounts to about 71 percent of the standard dyeing carrier cost.

Plant Match 4. In the standard dyeing using Tanavol, a brown was dyed to the specified shade. The dyestuffs used for the navy were used for this shade also, but the proportions were, of course, different. The match was made after two small adds. In the evaluation dyeing on the next day, Carolid was used. The dyeing was started with 70 percent of the dyestuff used in the standard dyeing. Three adds were made, and after five hours at the boil, the dyeing was completed. The match again was on the light side, but judged acceptable. Saving amounts to $5.13 per 100 pounds Dacron.

Plant Match 6. In the standard dyeing, Tanavol was used with another

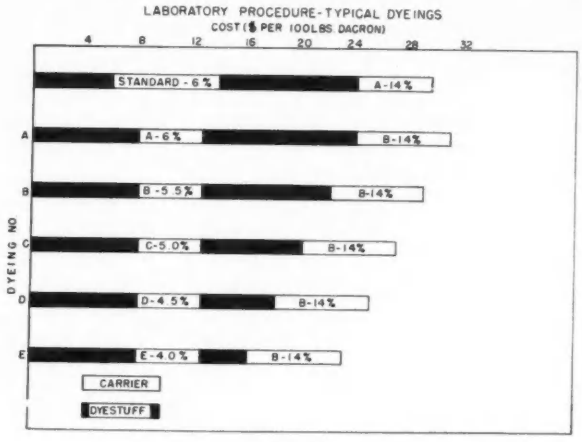

Figure 1

Figure 2

range of dyestuffs to produce a dark gray. The match was made with two adds. In the evaluation dyeing using Carolid, the dyeing was started with 70 percent of the total standard dyeing dyestuff, and the match was made with one small add after three hours at temperature. It was slightly off cast, but this will be corrected when dyeing the viscose. The saving using Carolid is $2.50 per 100 pounds Dacron.

All the dyeings above passed a careful inspection. The fastness properties were found to be acceptable. The modified phenol derivative carrier allowed a considerably more economical dyeing of shades obtained with the modified solvent carrier. This was true, even though the former carrier cost more. If the savings for the three dyeings above are averaged, they amount to about 62 percent of the cost of the modified solvent carrier.

LABORATORY PROCEDURE—— Carriers A and B mentioned under Plant Procedure above are to be evaluated in the laboratory. It is known that B gives better color values than A. In the plant procedure the carrier A dyeing was matched by making adds of dyestuff to one carrier B evaluation dyeing. In the laboratory, a number of carrier B dyeings are made simultaneously with the standard dyeing, under the same conditions of time, temperature, etc, using the same and gradually decreasing amounts of dyestuff. This technique is exact and avoids difficult and time-consuming color matching. A typical series would be:

a) Set up a standard dyeing, using 14 percent carrier A and 6 percent dyestuffs, both on the weight of the Dacron, as in the plant dyeing.

b) Set up comparative dyeings with the recommended amount of carrier B, ie, 14 percent carrier B and a) 6, b) 5.5, c) 5.0, d) 4.5, e) 4.0 percent of the same dyestuffs as in the standard above.

The dyeings are not run until a final match is made, but for a given period of time, say three hours at 208° F. When they are completed the standard is compared to dyeings a, b, c, d, and e. These show gradually decreasing color values, and it is rather easy to find a match for the standard dyeing. Corresponding depths of shade are determined readily even though dyeings made with different carriers usually do not have the same cast. The total cost of carrier and dyestuff is then computed for each dyeing, as illustrated in Figure 1. The difference in cost between the carrier A standard dyeing and the matching carrier B dyeing measures the difference between the carriers with respect to the shade dyed. If the appearance and fastness properties of the dyeings are acceptable, and the standard dyeing is matched by dyeing d, carrier B is a much better carrier than carrier A because the same shade was achieved for $4.60 less, which amounts to about 82 percent of the $5.60 carrier A cost in the standard dyeing.

The volatility of a carrier, ie, the dyeing time after which additional amounts of dyestuffs will not be absorbed by the goods, may be in doubt. It is determined by running dyeings similar to the above, except that only two-thirds of the dyestuff to be used is added initially, and the remainder after two hours at dyeing temperature. A difference in volatility between carriers. A and B will show up in the results.

A considerable number of laboratory evaluation dyeings were made in a mechanically agitated beaker bath designed for this purpose. Twelve 20-gram dyeings can be made at one time in 1000-ml dye pots. A 20:1 water-to-goods ratio is preferred because it approximates dyebeck conditions. 20-gram swatches are folded in thirds. A seam is sewn along one of the folds to form a loop which allows the swatch to be threaded on a heavy wire spiral as illustrated in Figure 2. Another wire spiral is inserted in the bottom loop of the swatch. The upper spiral moves up and down at the rate of about 30 strokes a minute. The length of each stroke is 4 inches, and the swatch is alternately squeezed and stretched. Each beaker is provided with a vented rubber cover and a gasket, which prevents loss of dye liquor by splashing. The beakers are placed in the usual steambath. As they are covered, dyeing temperatures of 210-211° F are easily attained. After three hours at this temperature, only about 60 mls of dye liquor evaporate, and this loss is quite uniform.

Evaluation dyeings were run mostly on heavy shades, ie, 5 to 7 percent dyestuff based on the weight of the Dacron present. Combinations such as browns, navies and grays allowed for better visual evaluations than single dyestuffs because of the different casts caused by different carriers. Dyeings on 100 percent Dacron goods did not show differences as clearly as dyeings on goods where the Dacron was blended with a fiber not stained by disperse dyestuffs, such as viscose. Dyestuff concentrations of about 2.5 percent based on the weight of the Dacron gave results comparable to those of the heaviest dyeings.

The results from a series of carrier evaluation dyeings made according

to the laboratory procedure are submitted. They do not cover the entire field, and are useful mainly as an illustration of the method.

The dyestuff combination chosen for the series was a brown consisting of:

	Lbs	Cost/lb $	Total Cost $
Acetamine Yellow 4RL	1.8	3.14	5.65
Latyl Blue BG	1.3	7.67	9.97
Latyl Violet BN	1.4	2.18	3.05
Latyl Cerise B	1.5	5.03	7.55
Total dyestuff	6.0	4.37	26.22

The goods dyed were a blend containing 50 percent spun Dacron and 50 percent viscose. Water-to-goods ratio was 20:1. All dyeings were run for three hours at 210° F. In all cases, the dyeing with the carrier to be evaluated was made simultaneously with a number of dyeings at the same and at decreasing dyestuff concentrations made with another carrier, as illustrated in Figure 1. Carriers were used at the rate recommended by the manufacturer, or at what was deemed the lowest concentration at which satisfactory fastness and appearance results were obtained. A tabulation of the carriers used in this series, as well as sets of the specific dyeings made, are shown on Table II.

TABLE II

Designation	Cost/lb	Type of Carrier
Carolid —C	$.59	modified phenol derivative
Carrier —M	.26	emulsifiable phenol solution
Carrier —N	.20	modified solvent
Carrier —P	.38	solvent
Carrier —Q	.30	modified solvent
Carrier —R	.30	solvent
Tanavol —T	.47	modified solvent
Tanalon —U	.38	solvent

Evaluation Dyeings

M—C

Carrier %	Dye %
M 32	6
M 21.7*	6—
M 10	6
C 12	6
C 12	5.4
C 12	4.8
C 12	4.2—

*best M dyeing

N—C

Carrier %	Dye %
N 14	6—
C 12	6
C 12	5.4
C 12	5.1
C 12	4.8—
C 12	4.5

N—C

Carrier %	Dye %
N 14	6*—
C 12	6*
C 12	5.4*
C 12	5.1*
C 12	4.8*
C 12	4.5*
C 12	4.2*—

*25% of dye added after 2 hrs at 210° F

P—U—T—C

Carrier %	Dye %
P 12	6—
P 18.65	6—
U 12	6
U 12	5.4
U 12	5.1—
T 12	6
T 12	5.4
T 12	4.8
T 12*	4.5—
C 12	6
C 12	5.4
C 12	4.8
C 12	4.2
C 12*	3.9—

*estimated—no actual dyeings

Q—T—C

Carrier %	Dye %
Q 12	6—
T 12	6=
T 12	5.4—
T 12	5.1
T 12	4.8
C 12	6
C 12	5.4
C 12	5.1
C 12	4.8=
C 12	4.5—
C 12	4.2

R—U—T—C

Carrier %	Dye %
R 12	6—
U 12	6
T 12	6=
T 12	5.6
T 12	5.2—
T 12	4.8
T 12	4.2
C 12	6
C 12	5.6
C 12	5.2
C 12	4.8=
C 12	4.2—

T—C

Carrier %	Dye %
T 14	6—
C 14	6
C 14	5.5
C 14	5—
C 14	4.5
C 14	4.0

— and = designate matching dyeings.

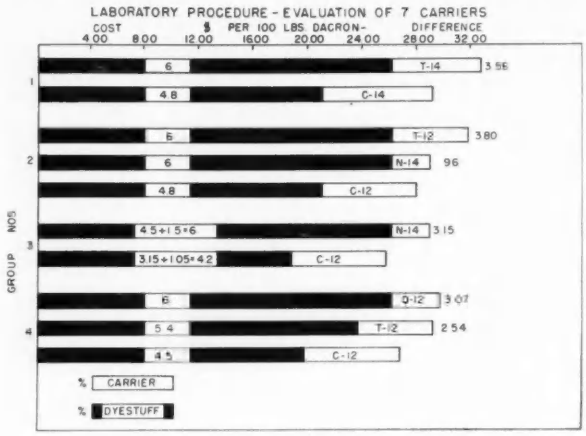

Figure 3

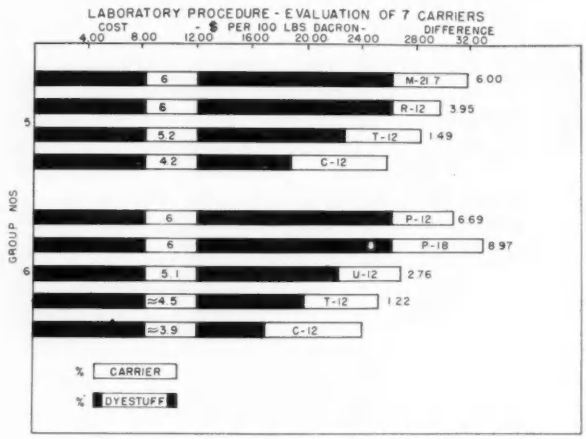

Figure 4

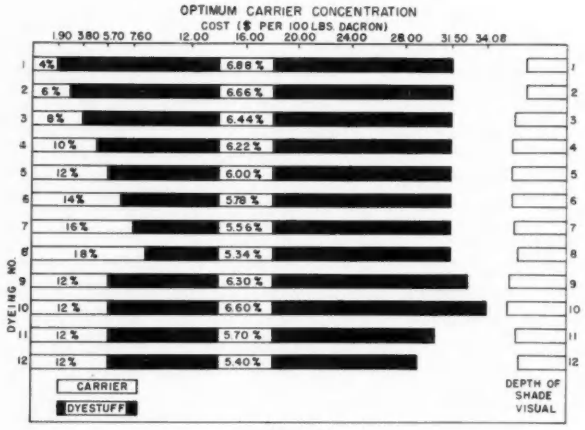

Figure 5

Only the matching dyeings from each set are shown on bar graphs, Figures 3 and 4. To consolidate the results, identical dyeings, ie, those made with equal amounts of dye and equal amounts of the same carrier, are shown only once. Each bar represents a dyeing, and each group of bars, matching dyeings. The lowest bar in each group is the matching dyeing made with the least amount of dyestuff. Each carrier is thus classified by the amount of dyestuff it was able to exhaust compared with all others evaluated in the series. In addition, the difference in cost between

each dyeing and the most economical dyeing in each group is indicated to the right of each bar. All costs are based on 100 pounds Dacron.

It is quite evident that the modified phenol derivative carrier utilized more of the dye present, and gave more economical dyeings, than modified solvent carriers, emulsifiable phenol solution carriers, and solvent carriers. Because of its low cost, modified solvent carrier N was very close to modified phenol derivative carrier C (Figure 3, Group 2). But when the same evaluation was repeated with 25 percent of the dyestuff withheld until two hours of dyeing time had elapsed, to check the volatility of the carriers, the difference became much greater (Figure 3, Group 3). There are also considerable differences within each group which are clearly resolved by the method used.

In dyeings on other goods, such as 100 percent spun Dacron, and 55 percent Dacron - 45 percent wool, and with a variety of dyestuffs and combinations, Dowicide A (o-phenylphenol sodium salt) proved to be about equivalent to Carolid, modified phenol derivative carrier. Methyl salicylate emulsions (4) were found to be roughly equivalent to the better modified solvent carriers. Benzoic acid, salicylic acid, and phenyl methyl carbinol were found to be uneconomical, together with a number of high-priced chemicals and proprietary carriers.

DETERMINATION OF OPTIMUM CARRIER CONCENTRATION

From the preceding discussion it is apparent that the most important property of a carrier is evaluated by matching a given shade at the lowest possible cost, that is, with a minimum amount of dyestuff and at the lowest carrier concentration that will give acceptable dyeings. This concentration is the optimum carrier concentration. A tentative method to determine it, which takes the cost factor into consideration, was developed. It is best described by a specific example.

The optimum concentration of modified phenol derivative carrier W for dyeing a certain heavy brown is to be determined. The goods to be dyed are a blend of 50 percent spun Dacron and 50 percent viscose. It is known that the shade can be satisfactorily dyed with 12 percent carrier W and 6 percent dyestuff, both based on the weight of the Dacron present. Carrier W costs $.475 per pound, the

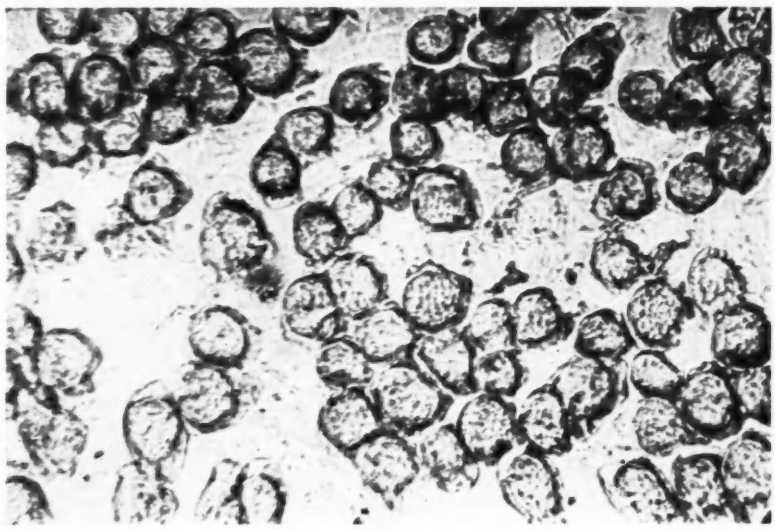

Figure 6

dyestuff combination used

Acetamine Yellow 4RL	1.8%
Latyl Blue BG	1.3%
Latyl Violet BN	1.4%
Latyl Cerise B	1.5%

about $4.30 per pound, which amounts to a total dyeing cost of $31.50 per 100 pounds of Dacron. The dyeings specified in Figure 5 are now run simultaneously for three hours in the mechanically agitated beaker bath described above. Dyeings 1 through 8 will show the heaviest shade obtainable for $31.50 from carrier W and the dyestuff used, varying the carrier concentration from 4 to 18% owf in 2% owf increments. The heaviest $31.50 shade can then be compared to dyeings 9 through 12, which show the effect of increasing and decreasing the amount of dyestuff used by 5 and 10 percent, while leaving the carrier concentration constant at the 12% owf standard.

The results are also indicated on Figure 5. They show that the $31.50 dyeings increase in depth of shade with the carrier concentration until 10 percent is reached. The depth of shade then remains about equal up to 14 percent carrier concentration, and then goes down as carrier concentration increases to 16 and 18 percent; however, the 18 percent dyeing (8) is better than dyeings 1 and 2, and the 16 percent dyeing (7) is about equal to the 8 percent dyeing (3). None of the carrier variations resulted in an improvement that approached what a 10 percent dyestuff addition achieved in dyeing 10. It may be concluded that 10 percent is the minimum carrier concentration to be used for the particular shade.

A severe scour with 2 percent sodium hydrosulfite and 1 percent caustic soda did not affect the results significantly. The appearance of all dyeings was acceptable with the exception of dyeings 1 and 2, which were somewhat uneven. Fastness to dry and wet crocking was acceptable for all dyeings. Fastness to laundering was best for dyeing 8, using 18 percent carrier. It was poorest for dyeings 1, 2, 3, and 4. All others were approximately equal. Fastness to drycleaning was poorest for dyeing 1, somewhat better for dyeings 2 and 3, and about equal for all others. A microscopic examination showed poor dyestuff penetration for dyeing 1, made with 4 percent carrier; better dyestuff penetration for dyeing 5, made with 12 percent carrier; and good penetration for dyeing 8, made with 18 percent carrier. Microphotographs of these dyeings are shown in Figures 6, 7, and 8.

Final conclusions from this series of dyeings are: 12 percent carrier W is the minimum amount of carrier to be used for this shade and construction. While the microscopic examination showed that penetration was not perfect, the fastness properties were acceptable. Additional amounts of carrier will tend to improve both penetration and fastness properties.

Other dyeings of this type made on 100 percent spun Dacron goods confirmed the results obtained on the 50 percent Dacron - 50 percent viscose blend. They also showed that tarring occurs more often where there is a deficiency of carrier.

It is recognized that the validity of the tentative method given above suffers because the standard dyeing is chosen rather arbitrarily. A future paper on the determination of the

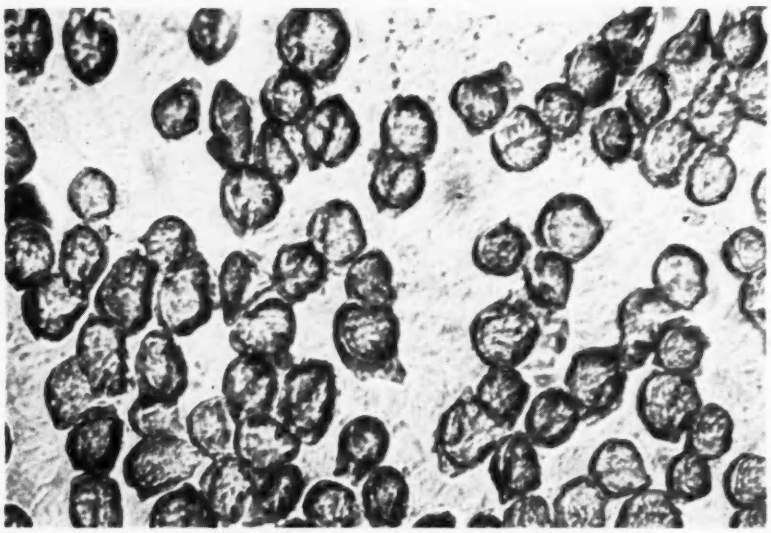

Figure 7

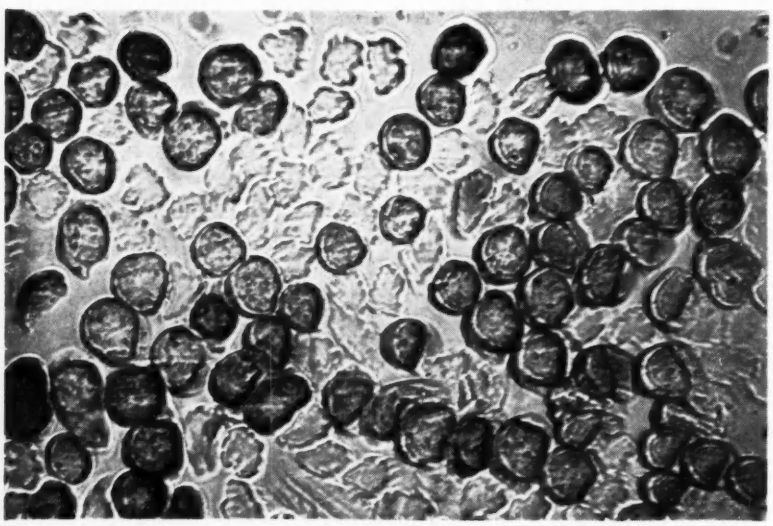

Figure 8

optimum carrier concentration may be based on the following scheme.

1) Determine the cost of the heaviest dyeing obtainable from a constant amount of dyestuff with increasing carrier concentrations.
2) Attempt to match the heaviest dyeing obtained by increasing the dyestuff concentration in small increments and decreasing carrier concentration in such a way that total dyeing costs will be less for each dyeing.

Note: Prices of various dyestuffs and carriers quoted in this article were those in effect on March 25, 1957.

SUMMARY

A significant comparison of two carriers, A and B, is to determine the cost of matching, with carrier B, a shade obtained with a given dyestuff formulation and carrier A, using varying amounts of the same dyestuff formulation. The comparison is valid only if the appearance and fastness properties obtained are satisfactory.

A tentative method to determine the optimum carrier concentration for dyeing a given shade, where the cost factor is given consideration, is described.

ACKNOWLEDGEMENT

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TRADEMARKS

The names Carolid, Tanalon, and Tanavol are registered trademarks of The Tanatex Chemical Corp, Kearny, NJ; the name Dowicide is a registered trademark of The Dow Chemical Co, Midland, Mich; the names Acetamine, Dacron, and Latyl are registered trademarks of E I du Pont de Nemours & Co, Inc, Wilmington, Del; the name Terylene is a registered trademark of Imperial Chemical Industries, Ltd, Millbank, London, UK; and the name Interchem is a registered trademark of Interchemical Corp, Hawthorne, NJ.

Washington

THE Washington Setcion held its final meeting of the season on Friday, April 11, at the National Housing Center, Washington, DC, with 46 members and guests in attendance.

The technical speaker of the evening was Fred Fortess, manager of dyeing and finishing, Celanese Corporation of America, Charlotte, N C, who presented a talk reviewing and summarizing "Recent Developments in the Chemical Finishing of Textiles."

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Establishing a Radiochemical Laboratory———

(concluded from Page 298)

viz, Geiger-Mueller Tubes, thin-window flow counters, windowless flow counters, ionization chambers, and scintillation counters.

A simple and reasonably versatile counting assembly for a small radiochemical laboratory would consist of a Geiger-Mueller Tube (approximately $50) and shield (approximately $315), a thin-window flow counter (approximately $325) and a shield (approximately $315) or a windowless flow counter (approximately $450), and a scaling unit which contains an amplifier circuit (approximately $1000).

The laboratory and counting equipment described above would provide the basic facilities required for a technical group of 1 to 4 people.

SOURCES OF SUPPLY

A definitive list of commercial suppliers for all laboratory equipment, radiochemicals, film badge and waste disposal services, and nuclear instrumentation is published each year in the November issue of the journal, *Nucleonics*. Technical brochures and literature are available from all companies listed.

In addition, catalogs describing products and services offered by Oak Ridge National Laboratory, Oak Ridge, Tenn and Atomic Energy of Canada, Ltd, Commercial Products Div, P O Box 93, Ottawa, Canada, can be obtained from these installations.

CONCLUSIONS

Several fruitful areas for studies on textile problems utilizing radioactivity now exist, and, undoubtedly, more will be uncovered as efforts are expanded in this field.

The costs involved in developing a small radiochemical laboratory are not prohibitive when compared to the capability such a facility offers for solution of a variety of complex textile problems.

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Northern New England

AT its March 28th meeting, held at the Commander Hotel, Cambridge, Mass, the Northern New England Section heard Graham M Richardson, Technical Services Section, Textile Fibers Dept, E I duPont de Nemours & Co, Inc, speak on the subject "Nylon Carpet—Growth and Technology." Co-author of the paper is Joseph W Lynch, also of DuPont. The paper was presented as an interesting example of the growing importance of man-made fibers in the textile industry.

Dr Richardson emphasized the tremendous growth of the use of nylon fiber in carpeting in the last few years, and his data indicated that a tremendous upswing had occurred during the last two years. The principal reasons for the acceptance of nylon as a carpet fiber are its durability, its recovery from crushing, its price stability, its versatility (as to spinning systems and carpet styles), ease and performance of twist setting, ease of cleaning, mildew and insect resistance, nonsupport of combustion, and ease of dyeing to a fast range of shades.

Dr Richardson showed data and exhibits to illustrate each of the above points and further indicated that Du Pont studies had resulted in 15-denier nylon carpet staple as the best choice at the moment. This staple is made in four types as follows: Type 100 has a bright luster; Type 101, which is "crimp set" in bright luster; Type 600, which is dull; and Type 601, which is "crimp set" in a dull luster.

Dyeing methods were discussed and a wide range of color types and dyeing methods indicated. The ability to set twist was discussed also, as well as means of making the twist setting more uniform by "dry tumbling" of the yarn skeins and before setting.

Richardson

The control of fuzzing and pilling has been subject to considerable study and these problems have been well rationalized as the result of development of test methods and mill processing procedures.

Considerable testing has been done by the Du Pont Company, most of which has demonstrated that nylon makes an extremely durable carpet material. An opinion survey was conducted by a marketing research organization, the result of which indicated a very satisfactory acceptance by the consumer. 76% of the owners of nylon carpets said they would purchase that type in the future.

Chairman Edward B Bell, Textile Aniline & Chemical Co, presided at the meeting. Plans for the meeting were made by Robert D Robinson, Bachmann-Uxridge Worsted Co, Inc, Div of Amerace Corp, vice chairman of the Section.

The Section's next meeting will be held this Friday (May 9) at the Lowell Technological Institute, Lowell, Mass, in conjunction with the LTI Student Chapter, which arranges the program for the annual joint meeting.

Membership Applications

SENIOR

David M Barbee—Laboratory dyer, Collins & Aikman Corp, Albemarle, NC. Sponsors: A R Thompson, E P Ward. (P).

Lex Basinger—Asst resident mgr, Stead & Miller Co, Concord, NC. Sponsors: A R Thompson, J L Lancaster. (P).

Henry J Carlin—Chemist, E J Feeley Co, Brighton, Mass. Sponsors: G O Linberg, W A Stickney Jr. (NNE).

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James B Clarke—Sales representative, National Aniline Div, Allied Chemical Corp, Portland, Ore. Sponsors: R E Newman, C Hancock. (PNW).

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Sam J Dunlap—Supt, finishing plant, International Textile Mills, Inc, Manila, Philippines. Sponsors: W B DePass, W H Scott.

Carlos A Gomez—Gen mgr & tech director, Argo SA, Mexico, DF, Mexico. Sponsors: M L Kesler, G L Morgan.

John C Hope—Asst laboratory director, Collins & Aikman Corp, Albemarle, NC. Sponsors: W D Hatrock, S G Hasty. (P).

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Joseph Werbiska—Dyer, Bruck Mills, Ltd, Cowansville, Que, Canada. Sponsors: W Olpinski, J Shower.

ASSOCIATE

Doris J Brockway—Associate prof of home economics, School of Home Economics, Univ of Washington, Seattle, Wash. (PN).

Imogene M Ford—Teacher (instructor) clothing & textiles, West Virginia State College, Institute, W Va. (S).

Paul E Grunder—Sales engineer, Dow-Corning Corp, New York, NY. (Met).

Lars E Nilsson—Chief chemist, Svenska Yllekoncernen AB, Boras, Sweden.

JUNIOR

William B Elmer—Technical salesman, Shell Chemical Corp, Atlanta, Ga. Sponsors: J McNab, D Meriweather. (S).

Allen A Gwinnell—Asst supt, Berkshire Woolen Co, Pittsfield, Mass. Sponsors: V J Lavelle, R F Gariepy. (WNE).

STUDENT

Gerald B Andrews, Harrison P Baker, Jerold Bozeman, Charles E Gavin, William Huddleston, Gerold D McGill, Jesse Meadows, Tillman L Miller, Bobby B Mosley, William F Newton, and Gordon C Temple—Students, Alabama Polytechnic Institute, Auburn, Ala. Sponsor: J H Cox. (A).

TRANSFER TO SENIOR

Harold G Ward—Textile chemist, Textile & Technical Service Dept, American Viscose Corp, Marcus Hook, Pa. Sponsors: W S Sollenberger, J A Woodruff. (DV).

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APRIL 10, 1958

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Monica C Meagher
Frederick Warlick
Thomas L Williams
George Zaloom

TRANSFER TO SENIOR

John L Waldo
Armand Dimeo
Louis J Provenza

Future Papers

"Pollution Control of New England Interstate Waters"—Joseph C Knox, New England Interstate Water Pollution Control Commission

"Disposal of Combined Textile Finishing Wastes and Domestic Sewage"—George C Bogren, Weston & Sampson

"Treatment of Mixtures of Textile Wastes and Domestic Sewage. IV—Research in Various Methods of Treatment"—R Hobart Souther and Thomas A Alspaugh, Cone Mills Corp

"Combined Treatment—Bleachery Waste and Domestic Sewage"—John L Brown Jr, Cannon Mills Co

"The Colorimetric Properties of Bleached Cotton"—E S Shanley, Arthur D Little, Inc.

"Recent Developments in Electronic Instruments for Textile Processes"—R Hosmer, The Foxboro Co

"Nuclear Energy—A New Tool for the Textile Industry"—Henry A Rutherford, North Carolina State College

"Automation with Process Instruments"—W H Ridley, The Foxboro Co

"Prevention of Wool Fabric Shrinkage with Polyamide—Epoxide Resin Finishes"—C E Pardo and R A O'Connell, Western Regional Research Laboratory, USDA

"Elimination of Static Electricity from Textiles by Chemical Finishing"—E I Valko, G C Tesoro and W Ginilewicz, Onyx Oil & Chemical Co

"The Mechanism of Dyeing Orlon 42 Acrylic Fiber"—T Vogel, J M A deBruyne and C L Zimmerman, American Cyanamid Co

"Some Considerations on the Azoic Insoluble Dyes in Printing"—Dorel Marian, Compagnie Francaise des Matieres Colorantes

"Reactive Dyestuffs in the Dyeing of Cellulosic Textiles"—Maurice R Fox, Imperial Chemical Industries, Ltd.

"Some Aspects of Cellulose Reactive Dyes and Practical Experience in their Application"—Fernand Schlaeppi, Ciba Co, Inc

"Practical Emulsions" — Paul Becher, Atlas Powder Co, Inc

"The Dyeing of Nylon and Dacron Polyester Fiber Yarns"—G T Hug, E I duPont de Nemours & Co, Inc

Employment Register

This column is open for two insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the secretary of the Association, Post Office Box 28, Lowell, Mass. It is understood that these will be open to inspection by prospective employers who can obtain further information from the secretary.

58-8

Education: Univ of Cincinnati, Ph D chemistry.

Experience: 21 years, variously as organic chemist (isolation and identification), biochemist (amino acids and vitamins), textile chemist (thermosetting and thermoplastic resins, catlysts, and softeners; syntheses and applications, lab and mill), and consultant. Speak, read, and write 9 languages. Honor societies, publications, and patents. Resume on request.

Age: 42; single; 1 dependent; references.

Position desired: Research director, assistant research director, senior research chemist, technical service.

Location desired: New England; Continental USA and foreign acceptable.

5-5, 5-19

PAPERS FOR 1958 CONVENTION

INDIVIDUALS and firms desiring to present papers at the AATCC Convention in Chicago, Oct 30-Nov 1, 1958 should send 100-200 word summaries to:

Leonard J Armstrong
Varney Chemical Corp
Janesville, Wisconsin

before May 15, 1958.

Papers should be of interest to a large segment of the textile industry. Oral presentation should be streamlined to a 20-minute delivery time.

AATCC Calendar

COUNCIL
May 23 (Sheraton Hotel, Philadelphia, Pa); Sept 19 (Charlotte, NC); October 30 (Conrad Hilton Hotel, Chicago, Ill); May 1959 (Montreal, Canada)

NATIONAL CONVENTIONS
Oct 30-Nov 1, 1958 (Hotel Conrad Hilton, Chicago); Oct 8-10, 1959 (Sheraton Park and Shoreham Hotels, Washington, DC); Oct 6-8, 1960 (Sheraton Hotel, Philadelphia, Pa); September 28-30, 1961 (Buffalo, NY)

DELAWARE VALLEY SECTION
May 23 (Outing, Torresdale-Frankford Country Club), Sept 12 (Wilmington Meeting), Oct 17, Dec 5

HUDSON-MOHAWK SECTION
May 16 (Ladies Night, Chelsea House, Tribes Hill, NY); June 20 (Annual Outing, Antler's Country Club, Ft Johnson, NY)

METROPOLITAN SECTION
June 6 (Outing, North Jersey Country Club, Wayne Township, NJ)

MID-WEST SECTION
June 13-14 (Outing—Browns Lake Resort, Burlington, Wis)

NIAGARA FRONTIER SECTION
June 27 (Annual outing); Sept 26 (Niagara Falls, Ont); Oct 24 (joint meeting with CATCC at St Catherines, Ont)

NORTHERN NEW ENGLAND SECTION
May 9 (Lowell Technological Institute, Lowell, Mass); Sept 12 (Outing—Wachusett Country Club, West Boylston, Mass); Oct 17 (QM Research & Development Ctr, Natick, Mass); Dec 5 (Hotel Vendome, Boston, Mass); Jan 16 (Colonial Club, Lynnfield, Mass)

PIEDMONT SECTION
June 6-8 (Outing—Grove Park Inn, Asheville, NC); Sept 19-20 (Hotel Charlotte, Charlotte, NC)

RHODE ISLAND SECTION
June 13 (25th Annual Outing—Wannamoisett Country Club); Sept 26 (Management Night—Warwick Country Club); Oct 23 (Providence Engineering Society); Dec 4 (Annual Meeting—Johnson's Hummocks Grille, Providence)

SOUTH CENTRAL SECTION
May 30-31 (Summer outing—Hotel Greystone, Gatlinburg, Tenn); Sept 13 (Hotel Patten, Chattanooga, Tenn)

SOUTHEASTERN SECTION
June 6-7 (Summer outing—Radium Springs Lodge, Radium Springs, Ga); Sept 13 (Ida Cason Callaway Gardens, Chipley, Ga); Dec 6 (Atlanta, Ga)

WESTERN NEW ENGLAND SECTION
May 16 (Ladies Night—Rapp's Paradise Inn, Ansonia, Conn); June 13 (Outing—Wallingford Country Club, Wallingford, Conn); Sept 26 (Hartford, Conn); Oct 24 (Annual Meeting—Rapp's Restaurant, Shelton, Conn); Dec 5 (Rapp's Restaurant, Shelton, Conn)

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Further Particulars from

American Association of Textile Chemists and Colorists

PO Box 28, Lowell, Massachusetts

• PATENT DIGEST •

DISCHARGE OF VAT-DYED FABRICS———Vinyl Pyrrholidone Polymers Added to Standard Reducing Paste D,2,02

Brit Pat 776,721 (Bad Anilin- & Sodafabrik—June 12, 1957)

Vat dyeings rarely can be discharged in a satisfactory way by standard reducing pastes; some of the dyes, for example, Indanthrene Blue RS, Indanthrene Orange RRT and many others, mentioned in the preamble to this specification, cannot be discharged at all in printing practice.

In contrast, it has been observed that vat dyeings, considered to be difficult or even impossible to discharge, can be *discharged white* by adding to the reducing paste water-soluble polymers of N-vinylpyrrholidones or their water-soluble copolymers with other vinyl compounds. The polymers or copolymers are dissolved in water and added to the regular discharge paste in an amount of 20-60% b w. The paste contains, in addition to the thickener (preferably the sodium salt of cellulose glycollic acid ether), one of the known reducing agents and a quaternary ammonium compound. The printed fabrics are aged as usual and, preferably, aftertreated with alkaline agents. A further aftertreatment of the aged goods with an aqueous solution of a reducing agent, such as hydrosulfite-soda, is optional.

Example: A cotton or viscose rayon fabric may be printed with a paste containing 585 g of a 20% aqueous solution of poly-N-vinylpyrrholidone ("K value" 60), 150 g trimethyl benzyl ammonium chloride, 75 g cellulose glycollic acid ether (sodium salt), 75 g Rongalite C, 75 g potash and 40 g precipitated titanic acid. It is thereupon dried, aged for 5-10 min at about 100° C, washed, and soaped. Among the dyeings made dischargeable white by the above paste are those made with Indanthrene Blue RS, Indanthrene Olive Green B, Indanthrene Brilliant Violet RR, and other dyestuffs. According to another example (#6), the printed and aged fabrics may be immersed in a cold solution of sodium carbonate plus sodium hydrosulfite until the dyestuff is detached from the discharged areas, then soaped at the boil.

The K value mentioned in this specification is a constant characteristic for each polymer, correlated to the viscosity of the substance and its molecular weight. For further information, see the work of De Bell et al "German Plastics Practice" p 518. -N-polyvinylpyrrholidone has been used in war time as a substitute for blood plasma (Periston). Textile uses for this product, especially for stripping vat dyeings or prints, have been suggested by Braeuer in *Melliand Textilber* 32, 53-56 (1951).

PIGMENT DYEING OR PRINTING———Dyes Fixed by Regenerated Viscose Solutions D,4,07

Brit Pat 776,796 (Sandoz Ltd—June 12, 1957)

Brit Pat 752,341 (Soc Viscose Suisse) covers a method for the preparation of a dehydrated and stabilized cellulose xanthogenate solution: a viscose of 7% alphacellulose content and 7% b w NaOH is spun at —5° C into methanol and the coagulated xanthogenate is washed with ethylether and dehydrated. This viscose solution reportedly is stable and completely water soluble for one year when kept in the absence of air.

It is suggested that stabilized viscose solutions of this type be used as fixing solutions in printing with all kinds of pigment dyes. In addition to the dyestuff and the viscose solution, a "simple organic nitrogen compound," such as urea, thiourea, ammonium thiocyanate, hexamethylene diamine, etc, must be added as an important ingredient. These nitrogen compounds are found to lower the viscosity and to increase the stability of the viscose; moreover, they have the surprising effect of strengthening the depth of shade, and also of improving the fastness properties of the prints. A general formula for the pastes comprises 50 g pigment dye, 200-800 g stabilized viscose solution, and 40-400 g urea.

After being printed and aged, the xanthogenate-containing prints have to be regenerated, ie, precipitated and desulfurized, according to methods known in the manufacture of viscose. In a simpler way, these steps can be replaced by a steaming process at 100° C (p 3, lines 36-49) or by heating to temperatures between 120-130° C.

Example: A printing paste formed from 50 p of a 20% aqueous paste of hexachloro copper phthalocyanine (Phthalocyanine Green), 830 p water, 100 p thiourea plus 20 p stabilized sodium cellulose xanthogenate was printed on a viscose fabric. After being printed, dried at 450° C, treated in a sulfuric acid solution of sodium sulfate and zinc sulfate (precipitation) and then in a sodium carbonate-bicarbonate solution (desulfurization), rinsed and dried, green prints of outstanding fastness were obtained.

ANTISTATIC TREATMENT———Lanolin Deposited on the Fibers from Emulsions G,1

Brit Pat 767,771 (Lanolized Inc—Feb 6, 1957)

The preamble to this patent stresses the property of lanolin which corrects the "cold feel" of synthetic fabrics, imparting softness, elasticity and antistatic effects to synthetic and natural fibers. Lanolin has not been used widely in the finishing of fabrics because it could not be deposited uniformly nor would it adhere sufficiently to the goods.

The current method calls for the application of lanolin *emulsified with cationic and nonionic agents* and precipitation of the substance by anionic surfactants upon the fabrics. Cationic emulsifiers preferably are of the quaternary-ammonium type. Any of the nonionic emulsifiers may be applied, eg, polymerized, long-chain substituted monoglycerides, sorbitan monostearate, or polyoxyetheylated condensates or the Igepal type. The anionic agent, which acts here as the precipitant, may be an alkali-neutralized sulfonated castor oil, a soluble soap, an alkyl aryl sulfonate, or the like.

The anion-active agent can be added to the last rinse after dyeing or before the treatment with the anionic-nonionic lanolin emulsion; in this event, an advantage is that the anionic agent, which is incorporated in the textiles, tends to equalize the lanolin coating more effectively. The lanolin emulsion is best kept stable in concentrated form and diluted with water before use.

Example: Nylon hosiery goods were first treated with an aqueous solution of alkali-neutralized sulfonated castor oil, then immersed in a 90-100° F bath adjusted to pH 8 and containing owf 8% lanolin, 15% distearyl dimethyl ammonium chloride and 5% polymonoglyceride of stearic acid (as the nonionic agent).

Reference may be made to the so-called substantive delustering methods, where a pigment is applied from a cation-active emulsion and precipitated within the fibers by an anion-active agent. This is described in Boehme Fettchemie's U S Pat 2,128,613 or Brit Pat 424,672. No durable antistatic effects are claimed in these patents, however.

VAT DYEING AND PRINTING———Metal Powders for Developing Hydrogen in Reduction C,4,02

Brit Pat 775,820 (Steimle—May 29, 1957)

According to this specification, one of the main reasons for faulty vat dyeings is the high affinity of the leuco vat dyes for cellulosic fibers, evidenced by inferior penetration and unlevelness of the dyeings or prints. Methods and equipment developed in recent times (eg, Williams Unit, Standfast Molten Metal Process) are briefly reviewed and criticized as unsatisfactory, complicated or expensive.

The problem reportedly has been solved by incorporating into the printing paste or in the padding preparation a metal such as aluminum, or preferably zinc, which develops hydrogen in "statu nascendi" in an alkaline aftertreatment according to the equation $Zn + 2NaOH \rightarrow Zn(ONa)_2 + 2H$. The metal, carried with the dyestuff preparation deeply into the fiber, is transformed there upon contact with excess lye and readily fixed without any risk of further migration. Any danger of sedimentation of the powdered metal in the padding liquor or within the paste (as has been observed frequently in the past in printing zinc-dust-containing pastes) can be countered by fitting a propeller agitator to the tank (see p2, lines 78-83).

Example: A padding solution was utilized consisting of Indanthrene Brilliant Green 2G paste, a dispersing agent of the polyethoxylated oleyl-alcohol type, zinc dust (about 1.5% of the solution), water and a British Gum—alginate thickener (10%). The impregnated goods were treated for one minute with NaOH 10° Bé at 70° C, then wet steamed for 4 minutes, rinsed, soaped at the boil, and further treated as usual. Other examples refer also to vat printing along the same lines.

POLYESTER FABRICS DYED WITH METALLIZABLE AZO DYES———Metal Coordination Compounds Applied C,4,07

Brit Pat 777,377 (Imp Chem Ind—June 19, 1957)

Dyeing of aromatic polyester fibers, such as Dacron (Terylene), with dispersed water-insoluble dyes does not give satisfactory results with respect to washfastness and resistance to dry heat. In dyeing with metallizable dyes, followed by an aftertreatment with water-soluble metal salts, difficulties have been observed, especially that of insufficient penetration of the metal salts into the core of the fibers.

According to the current patent, a solution of the problem is the use of a metallizing agent, such as Cu, Cr, Ni or Co, before or after dyeing, in the form of a coordination compound, generally *a chelate compound*. It must be free from ionizable groups, eg, the copper derivative of an aliphatic diamine (ethylene diamine), of an amino acid (amino acetic acid) of ketones (acetyl or benzoyl ketones), of oximes (salicylaldoxime), 8-hydroxyquinoleine, and others listed on pages 8-11 of this specification.

The dyes are applied in dispersed form, optionally together with a swelling agent, eg, diphenyl, at temperatures up to 100° C or at superatmospheric pressure above 100° C. The metal coordination compounds, being mostly sparingly water-soluble, are dispersed with sodium oleyl-p-anisidine sulfonate or other dispersants. They are applied before or after dyeing; sometimes the pretreatment may give better control of the final dyeing results.

After being dyed, the fabrics may be treated with a strong reducing agent (sodium hydrosulfite) plus cetyl trimethyl ammonium bromide to remove particles from the surface that have not penetrated the fibers.

Example: A polyethylene terephthalate fabric was immersed in a dyebath containing a dispersed metallizable brown azodye, dyed under pressure at 130° C for 30 minutes, removed, rinsed, and entered into a coppering bath containing the copper derivative of acetylacetone in aqueous dispersion. The copper bath was heated to 130° C under pressure for 30 minutes. After being rinsed, treated with the above-mentioned reducing agent and rinsed again, a deep brown, fast to light, washing and dry heat reportedly resulted.

DYEING WITH PRECIPITATED METAL OXIDES——— Heat Aftertreatment C,1

Brit Pat 778,415 (Crosland & Pickstone—July 10, 1957)

Dyeing of cellulosic fabrics by precipitating metallic hydroxides, especially of iron or chromium, within the fibers is well known in practice.

The current innovation comprises an aftertreatment of these fabrics at 120° C or above. It has been observed that the shade reddens and becomes generally deeper upon exposure to heat for a few minutes.

Example: A cotton fabric impregnated with a 15% solution of ferrous sulfate was dried in hot air, then aftertreated with cold sodium hydroxide (10%), and hung in the open air for drying and oxidizing. The brownish-yellow shade reportedly turned much deeper and redder following a 5-minute heat treatment at 145° C.

References to "iron buff" may be found, among other sources, in *Dyer* 73, No. 2, p 76 and *Indian Textile J* 62, 40-41 (1951) (Mukerjee) according to *Chem Abst* p 1767 h (1952). Several heat and steam aftertreatments are reported.

ICE-COLOR PASTES CONTAINING DIAZO AMINO COMPOUNDS ——— Neutral Steam Development D,2,04

Brit Pat 778,928 (Farbenfabr Bayer—July 17, 1957)

Printing pastes containing stabilized diazoamino compounds plus coupling agents, typified by the Rapidogens, Diagens, Pharmasols, and equivalent brands, must be developed in an acid or acid-steam aftertreatment. Attempts to incorporate latent acid agents, which act at elevated temperatures only, in order to replace acid steam, have been described in the past (ie, Brit Pat 466,846 of I G Farben).

An ideal solution would be—according to the current specification—to select special diazoamino components that are easily and completely split *per se* in neutral steam while being stable in the cold, *without resorting to* any additional *acid-splitting substance*. Diazoamino compounds combined from diazotized halogen-substituted aniline (or alkyl- or alkoxyaniline) and 2-alkylamino-4 or 5-sulfobenzoic acid were found to fulfill the above conditions. They are claimed to yield strong prints on cellulosic fibers when applied from an alkaline paste together with an ice-color coupling compound upon development in neutral steam. These pastes are very stable in the cold. A further advantage is that reducing and alkaline substances, carried over from vat colors in roller-printing operation, do not impair the shade of these azo-prints.

Example: The diazoamino compound is prepared from diazotized 1-amino-2-methyl-5-chlorobenzene plus 2-ethylamino-5-sulfobenzoic acid (a); the coupling component is Naphthol AS—OL (b).

(a) and (b) are mixed in stoichiometric proportions, some alcohol and caustic dissolved in water are added, and the mixture is stirred into a thickener. After being printed and steamed for 5-10 minutes in neutral steam, a clear, fast-to-light scarlet results.

Abstracts

New Finishing Techniques for Wash-and-Wear Cottons

Reid, J D, and Reinhardt, R M, *Modern Textiles* **39**, 61-8, March, 1958

Wash-and-wear garments, although they have many shortcomings, have a definite place in the textile market, according to the authors.

The development of resin finishes on rayon and cotton fabrics, starting in 1929, is reviewed. Urea-formaldehyde resins, followed by melamine-formaldehyde, were used at first mainly for crease resistance and dimensional stabilization. Later, with the appearance of wash-and-wear synthetic fabrics on the market, the cotton industry was forced to develop wash-and-wear cottons. New resins and new catalysts have contributed greatly to the success of these new finishes.

Urea-formaldehyde is the cheapest resin and the most widely used, but has the disadvantage of high chlorine retention, poor permanence and a tendency to polymerize in the treating bath. Melamine-formaldehyde gives greater crease resistance and better strength retention, but costs more.

A number of the newer resins are described. The epoxy resins, which are not of the methylol type and contain no nitrogen, are reported to be completely resistant to chlorine damage on bleaching, and show good wrinkle recovery and good strength retention. One of the newest resins is methylolated cyclic ethylene urea (CEU). This type of resin is being used more and more; it is cheaper than the melamine, and gives extremely high crease resistance.

The mechanism of the creaseproofing process is described at some length. Textile chemists are uncertain whether the resin polymers that form in the amorphous regions of the cellulose contribute to its increased wrinkle resistance mainly by their presence or by actual reaction with the hydroxyls of the glucose units, thus forming cross-links between cellulose molecules.

The authors describe a typical application of a wash-and-wear finish to cotton yard goods, using CEU. They point out some of the advantages of cotton garments over synthetic ones (eg, superior comfort, due to greater moisture regain).

More recently, the application of the resin to cotton garments has been investigated. The garment is impregnated with the resin formulation, centrifuged to 80% pickup, and hand-ironed at 200°C. It is thus dried and cured in one step. Such a garment has durable creases and good wash-and-wear qualities. These new developments are described in great detail.

The authors warn that some wash-and-wear fabrics on the market, which were cheaply and poorly finished, have inferior properties such as a tendency to yellow in strong light, reduced lightfastness, and poor chlorine resistance.

The Dyeing of Acrilan and Wool-Acrilan Blends

Lister, G H, *J Soc Dyers Col* **74**, 158-62, March, 1958

The author has studied the dyeing behavior of both Acrilan alone and blends of Acrilan and wool, using level-dyeing and milling-type acid dyes, neutral-dyeing metal-complex dyes, and chrome dyes. It was found that to obtain complete penetration of the Acrilan fiber, a high percentage of sulfuric acid in the dyebath was required in most cases, up to 5 percent on the weight of the fiber. Since some dyes are precipitated at this high acid concentration, it was found advisable to add a nonionic dispersing agent to the dyebath to prevent formation of tars.

In dyeing with chrome dyes, the development of the chrome lake is more difficult on Acrilan than on wool, and a higher dichromate content is required and a longer boiling time. Chrome dyes which are particularly sensitive to oxidation may be destroyed under these conditions. However, when the chrome dyes are used on blends, the presence of the wool is said to make the chrome development somewhat easier.

In dyeing blends of Acrilan and wool, it was found that the high percentage of acid required for the Acrilan caused some damage to the wool fiber (as determined by alkali-solubility tests); this lowered the resistance to abrasion. The author believes, however, that with the higher abrasion resistance contributed by the Acrilan, blends can be dyed without undue risk.

Solid shades can be obtained on these blends by two methods: 1) by starting the dyebath with a normal amount of acid, which allows the dye to go mostly on the wool, and later adding more acid together with a cationic agent, to effect transfer of dye from the wool to the Acrilan; 2) by starting with a strongly acid dyebath and an excess of cationic agent, so as to provide maximum affinity for the Acrilan.

The dyeing method which the author has used successfully on blends is as follows:

The dye is added to the bath, together with a combination of cationic and nonionic products (to prevent dye precipitation), followed by 5 percent sulfuric acid. The temperature of the bath is raised to the boil in 45 minutes, and boiling is continued for 1 hour.

When selected neutral-dyeing complex dyes are used, solid effects can be obtained on the fiber blends, according to the author, without the necessity of using such high percentages of acid.

New Method for the High-Temperature Dyeing of Acrylic Fibers

Khachoyan, J, and Niederhauser, J P, *J Soc Dyers Col* **74**, 133-8, March, 1958

The cuprous-ion method for the application of acid dyes to acrylic fibers, discovered in 1951, is referred to by the authors, who state that although the exact nature of the links between the cuprous ions and the fiber is not yet well established, positive charges are introduced into the fiber molecule, which permit the subsequent attachment of dye ions. Of the various reducing agents employed in this process, hydroxylamine sulfate is regarded as one of the most interesting.

Instead of producing cuprous ions in the dyebath by reduction of cupric ions, the authors conceived the idea of using copper-complex dyes, which in the presence of a suitable reducing agent might be modified in such a way that the dyeing of the acrylic fiber would become possible. They obtained positive results with this class of dyes, but only in presence of hydroxylamine or one of its salts as reducing agent, and only by dyeing at high temperatures. In this new method the fiber is dyed in a bath containing the dye and hydroxylamine sulfate at 120-130°C for ½ to 1 hour.

This method has been found to work successfully with the copper complexes of monosulfonated acid dyes, and also with the copper complexes of direct dyes. Chrome- and cobalt-complex dyes, both 1:1 and 2:1 complexes, also give good results; the 2:1 complex dyes possess very high affinities for the acrylic fiber when applied in this manner.

The authors also observed that even dyes containing no metal atom possess a much higher affinity for this fiber when applied with hydroxylamine. They state that the acrylic

polymer is chemically modified by the action of hydroxylamine (which combines with the nitrile group to form an amidoxime), and believe that this may explain the fiber's increased affinity for acid dyes.

Some Practical Aspects of the Fibrous Acetylation of Cotton Yarn

Bryant, F, *Textile Research J* **28**, 180-1, February, 1958.

In the production of cellulose acetate fibers, cellulose is customarily treated with a mixture of acetic anhydride, acetic acid and a catalyst. This produces a solution of cellulose triacetate, which is subsequently hydrolyzed to secondary acetate.

However, if sufficient quantity of a liquid nonsolvent is included in the liquor, solution of the cellulose acetate is prevented and a fibrous esterification results. Such esterification can transform cotton yarn into an essentially different fiber with some very important properties: ability to resist subsequent dyeing by a variety of dyestuffs, ability to withstand microbiological attack, increased electrical resistance, and increased heat resistance.

The present paper contains results of an investigation undertaken in order to secure a yarn exhibiting a complete "immunization" to certain specific dyes.

The first experiments were performed on both unmercerized and mercerized cotton, following the directions given in patents granted over 20 years ago. The results were unsatisfactory; either the immunization to direct dyes was only slight or the tensile strength of the fiber was greatly reduced.

An improved process developed by the writer is described in detail. It is recommended that the cotton yarn to be treated should be unbleached, mercerized, gassed and vat-dyed. The dyed yarn is first steeped for an hour, with agitation, in glacial acetic acid, squeezed, and immersed in a second solution containing acetic anhydride, toluene (a nonsolvent), and perchloric acid as catalyst, for 35 minutes. The skeins are allowed to drain, are dried, and are finally washed with water.

The author states that with this procedure a complete immunization to certain specific dyes is obtained with only slight loss in tensile strength.

Seven references to the literatures are cited.

Dyes for Anodized Aluminum

Anon, *Dyes & Chem Tech Bull (du Pont)* **13**, 174-7, December, 1957.

Lightfast dyes for anodized aluminum represent a growing color potential, particularly in architectural fields where the light-weight metal is being employed in outdoor exposures. While consumption of dyes in coloring aluminum is small, the expanding use of the metal for building exteriors shows the need for a complete, lightfast range of shades.

The 18 dyes recommended by the author for use in coloring the anodized aluminum were selected on the basis of their lightfastness. They include both acid and direct dyes, the latter group being recommended chiefly for deep blue and black shades.

The author describes the pretreatment of the metal (type 2-SH, 0.01 inch thick, was used). It is first cleaned in a solution of sodium silicate, sodium carbonate and trisodium phosphate at 200-210° F, and is anodized for 45 min to 1 hour at 75° F in an electric current, using a 15% sulfuric acid solution as the electrolyte. This treatment deposits a film of aluminum oxide on the metal.

The dyeing is conducted, usually at a pH of 5, for 20 minutes at 150° F.

To obtain maximum fastness and stability of shades, the dyed material should be sealed by further treatment in an 0.5% nickel acetate solution for 10 minutes at 205-210° F.

Du Pont LN Dyeing Process

Anon, *Dyes & Chem Tech Bull (du Pont)* **13**, 172-3, December, 1957.

This is a new dyeing process for acid dyes on nylon filament which is said to minimize the barré problem. It supplements the earlier Duponol D Paste procedure, and is especially recommended for use at 205-212° F (at temperatures above 212° F Duponol D is said to be still more effective).

In the new process, Alkanol LN, a surface-active agent, is used to complex the anionic acid dye in the bath. At a pH of 3.0 to 3.5 this complex gradually dissociates to liberate the free anionic dye, which is then absorbed by the fiber. Alkanol LN does not occupy dye sites within the fiber; therefore, little reserving action occurs even in heavy shades when the recommended amount is employed. Optimum results are obtained at 200-208° F.

The recommended dyeing procedure is as follows:

Set the bath at 120° F with 4-5% Alkanol LN. Run 10 minutes. Add 2.5 to 3.0% formic acid to pH 3.0 to 3.5. Run 5 minutes. Add the dissolved acid dyes. Heat to boil in 30 minutes and dye for 1 hour.

A list of suitable dyes is included. Selected level-dyeing acid dyes must be used. It is stated that Alkanol LN has no adverse effect on the fastness properties of the dyes used.

General Calendar

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
(1958 Gordon Research Conference on Textiles—July 7-11, Colby Jr College, New London, NH)

AMERICAN OIL CHEMISTS SOCIETY
July 14-18 (Short course on soaps and synthetic detergents, Princeton Inn, Princeton, NJ); Oct 20-22 (Sherman Hotel, Chicago); April 20-22, 1959 (Roosevelt Hotel, New Orleans, La; Sept 28-30, 1959 (Statler Hotel, Los Angeles, Calif)

AMERICAN SOCIETY FOR TESTING MATERIALS (COMMITTEE D-13)
Oct 14-17 (Sheraton McAlpin Hotel, New York, N Y)

THE DRYSALTERS CLUB OF NEW ENGLAND
June 20 (Outing—Wachusett Country Club, West Boylston, Mass)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS
June 9-12 (National Conference on Materials Handling, Public Auditorium, Cleveland, O)

CANADIAN TEXTILE CONFERENCE
May 6-8 (Queen Elizabeth Hotel, Montreal, Quebec)

DIVISION OF CLOTHING AND TEXTILES IN EXTENSION, TEACHING AND RESEARCH, UNIVERSITY OF GEORGIA
Nov 7-8 (2nd Textile Seminar, Georgia Center for Countinuing Education, Athens, Ga)

THE FIBER SOCIETY
Sept 9-10 (Montreal, Que)

INSTRUMENT SOCIETY OF AMERICA
May 12-14 (Analysis Instrumentation Division Symposium, Shamrock Hilton Hotel, Houston, Texas)

INTERNATIONAL TEXTILE MACHINERY EXHIBITION
Oct 15-25 (Belle Vue, Manchester, England)

LAUNDRY, DRYCLEANING AND ALLIED TRADES' EXHIBITION
July 17-26 (Olympia, London, England)

MANUFACTURING CHEMISTS' ASSOCIATION
June 12-14 (86th Annual Meeting, The Greenbrier, White Sulphur Springs, W Va)

NATIONAL COTTON COUNCIL OF AMERICA
Oct 1-2 (Chemical Finishing Conference, Washington, DC)

PURDUE INDUSTRIAL WASTE CONFERENCE
May 5-7 (Purdue Memorial Union Bldg, Purdue Univ, Lafayette, Ind)

SOUTHERN TEXTILE EXPOSITION
Oct 6-10 (Greenville, SC)

SYNTHETIC ORGANIC CHEMICAL MANUFACTURERS ASSOCIATION OF THE UNITED STATES
Luncheon meetings at the Hotel Roosevelt, New York, NY: June 10, Sept 9, Oct 8, Nov 12. Outing: May 26-28, Shawnee Inn, Shawnee, Pa

TUFTED TEXTILE MANUFACTURERS ASSOCIATION
June 5-7 (Dayton Plaza Hotel, Daytona Beach, Fla)

VOLUME 3

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News of the Trade

12 New American Standards for the Textile Industry Available

Availability of twelve new and revised American Standards for the textile industry has just been announced by the American Standards Association. They were submitted to ASA for approval by the American Association of Textile Chemists and Colorists and the American Society for Testing Materials, joint sponsors of the project in Textile Test Methods.

They are:

New:

L14.70-1956 American Standard for Colorfastness of Silk Textiles to Mill Washing AATCC Standard Test Method 4-52

L14.71-1956 American Standard for Colorfastness to Dry and Wet Heat (Hot Pressing) AATCC Tentative Test Method 5-52

L14.72-1956 American Standard for Colorfastness to Rubbing (Crocking) AATCC Standard Test Method 8-52

L14.77-1956 American Standard Changes in Wool Textiles (Accelerated Test) AATCC Tentative Test Method 41-52

L14.79-1956 American Standard Evaluation of Penetrants for Mercerization AATCC Tentative Test Method 43-52

Revised:

L14.2-1956 American Standard for Colorfastness to Acids and Alkalies AATCC Standard Test Method 6-52

L14.5-1956 American Standard for Colorfastness of Wool Yarn to Fulling AATCC Standard Test Method 2-52

L14.6-1956 American Standard for Colorfastness of Wool Textiles to Mill Washing and Scouring AATCC Test Method 1-52

L14.82-1956 American Standard for Evaluation of the Resistance of Wool Oils to Oxidation in Storage AATCC Standard Test Method 62-52

L14.83-1956 American Standard for Colorfastness to Water AATCC Standard Test Method 63-52

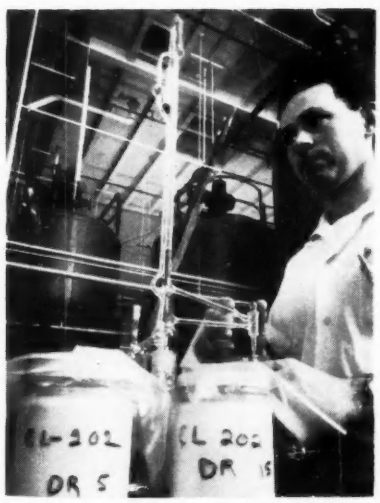
L14.86-1956 American Standard for Damage Caused by Retained Chlorine AATCC Tentative Test Method 69-52

L14.88-1956 American Standard for Shrinkage of Wool Hose: Accelerated Test AATCC Tentative Test Method 73-53

Important standard work is also done in this field by the International Organization for Standardization (ISO), Cyril Ainsworth, deputy managing director of the American Standards Association pointed out.

"The fact that these twelve standards have been approved by the ASA, which is the US member of the ISO, means that US textile people will have a unified national viewpoint to present in the preparation of any international standards through ISO," Mr Ainsworth said.

Copies of the standards are available at 30 cents each from the American Standards Association, 70 East 45 Street, New York 17, NY.



Shown here is a technician checking a sample of polyvinyl acetate emulsion for adherence to quality standards at Celanese Corp of America's new manufacturing unit at Belvidere, NJ. In the background are tanks in which the emulsion is mixed and is then drawn off for shipment.

New Celanese PVA Unit Completed

Celanese Corp of America has completed construction of a new manufacturing unit at its Belvidere, NJ, plant to produce polyvinyl acetate emulsions. Annual capacity of the installation is in excess of 20 million pounds.

Polyvinyl acetate emulsions were formerly produced at the Celanese plant in Linden, NJ, the facilities of which will now be employed exclusively for the manufacture of polyester resins. The Belvidere plant also turns out cellulose acetate and cellulose propionate molding powders, cellulose acetate extruded and cast film, and triacetate photographic film base.

L A Seeking Primary Textile Mills

"The operation of primary textile mills in Los Angeles area is not only feasible but inevitable and the mill first out there will gain a tremendous advantage." So stated Mayor Norris Poulson of Los Angeles at a luncheon meeting attended by the heads of several eastern textile mills, financial and other interested business men April 2 at the Manhattan Club, New York, NY.

Bud Whiser, chairman of the Mayor's Committee for the Development of the Textile and Apparel Industry, pointed out that the California apparel industry ships over $700,000,000 per year at wholesale costs.

The type and size of the proposed mills was discussed and described by Douglas G Woolf, of Fessenden Blanchard and Morrell, management and consultant firm under whose supervision the study was made.

"In our study we isolated the type of mill which we believe would be the soundest economic starter. It is one to produce print cloths, carded broadcloths, and related fabrics including spun rayon fabrics of similar construction," said Woolf.

"As the result of our state-wide survey, both as to market potential and manufacturing costs and conditions, it became evident that the Los Angeles area offers certain advantages, such as proximity to the major part of the apparel market, availability of adequate and reasonably priced water and power facilities, growth potential, and availability of types and quantities of labor required.

"Finally, we became particularly convinced that the California situation demands the type of mill especially geared to meet the particular demands of this highly diversified style market, with the most modern and efficient equipment. The California market is not one in which to 'retire' antiquated textile equipment," he added.

Louis Siegel, senior vice-president of the Union Bank and Trust Co, which has specialized in financing in the textile field, presented several possible plans for financing such a project. He, too, expressed confidence in the project, pointing particularly to the growth of the apparel industry during the past ten years in Los Angeles.

FMC Reorganizes Chemical Operations

Food Machinery and Chemical Corp has created two new operating chemical departments and enlarged its Executive Committee in a move to streamline the organization of its chemical operations.

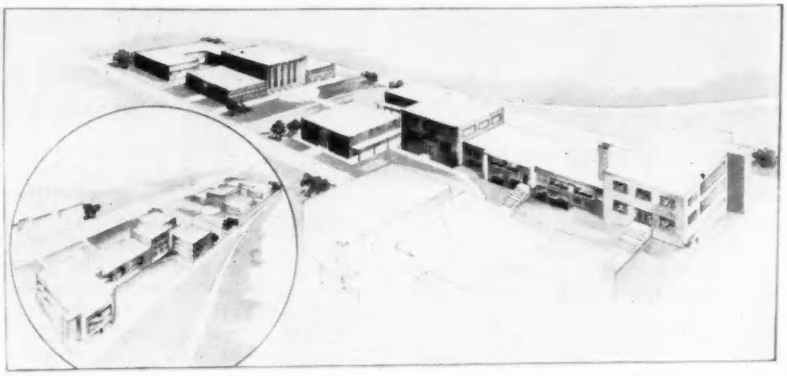
The new operating units are the FMC Organic Chemicals Department and the FMC Inorganic Chemicals Department. The first includes the Niagara Chemical Division and the Chemicals and Plastics Division, formerly the Organic Chemicals Division. The second comprises the Becco Chemical Division, the Westvaco Chlor-Alkali Division, and the Westvaco Mineral Products Division. All present products and trademarks will be retained while new product development efforts will be intensified, it is reported.

Alfred T Loeffler, FMC vice president, is general manager of the new Organic Chemicals Department. He will be assisted by R H F Dade, who has been named a vice president of the Chemical Divisions. General manager of the new Inorganic Chemicals Department is Frederick A Gilbert, who was previously manager of Becco Chemical Division and Westvaco Chlor-Alkali Division. Donald C Oskin will be assistant general manager under Mr Gilbert, and has been named a vice president of the Chemical Divisions.

The new division manager of the Westvaco Chlor-Alkali Division is Robert J DeLargey. He was formerly assistant division manager. Raymond F Moran becomes manager of the Westvaco Mineral Products Division. Earlier he had been manager of the division's Newark, California plant. Dewey H Nelson has been appointed manager of the Becco Chemical Division, having served previously as assistant manager and as sales manager.

Stuart Bear, formerly agricultural department manager of Niagara Chemical Division, is the new manager of this division. Henry S Winnicki continues as manager of the Chemicals and Plastics Division, formerly the Organic Chemicals Division.

The Chemical Divisions Executive Committee, which has management responsibility over all the Chemical Divisions, has been enlarged and strengthened by including Jackson V Vernon, William N Williams and J D Fennebresque, FMC vice presidents; and Emil Ott, director of research and development. They will serve with Carl F Prutton, FMC's executive vice president, on the committee, which also includes Bernard H Jacobson and Messrs Gilbert and Loeffler.



Artists' conception of NBIT campus after building program

Plans for NBIT Building Program Announced

Details of an extensive building and improvement program at the New Bedford Institute of Technology, involving the expenditure of $5,710,000 over a ten-year period were announced recently by President John E Foster. The Institute's Board of Trustees has approved the long-range program, which has been submitted to the State budget commissioner. State approval is not expected to be announced until the State's capital outlay program is prepared, Dr Foster said.

Major expenditures in the program include $1,500,000 for a new research and graduate school in 1967, a total of $1.200,000 for a new student union building in 1963, expenditure of $1,-150,000 in 1961 for a new arts and science building and $1,000,000 in 1966 for a new library and administration building.

President Foster announced that the expansion program has had months of study and is aimed to meet the needs of the college during the next 10 years. By 1967, Dr Foster stated, the enrollment at the Institute will be far over the 1000 mark.

Construction of an auditorium addition to the new building on the east side of Purchase Street is planned for 1960 at a cost of $300,000. An additional $65,000 is sought in that year for land and plans to enable expansion for future needs in the arts and sciences.

The 1962 outlay also includes $60,-000 for land and plans for development of an athletic field in the area of the institute. No outside facilities are now available. "Outside facilities for athletics are a requirement for the success of any college," Dr Foster said in announcing a $200,000 item for construction in 1964 for an athletic field and field house.

Annual expenditures under the long-range plans include $440,000 in 1960, $1,500,000 in 1961, $110,000 in 1962, $1,200,000 in 1963, $200,000 in 1964, $110,000 in 1965, $1,000,000 in 1966 and $1,500,000 in 1967.

Dr Foster also announced plans for the start of a Business Administration Department at the Institute. It is the plan of the administration to begin courses in Business Administration by September. Milton S Briggs, a superintendent of schools in New Bedford and a man long connected with business education in the New Bedford area, will head this newly created department.

"Research Management" Debut

The Industrial Research Institute, Inc and Interscience Publishers, Inc have announced, as a joint undertaking, a new journal, devoted to discussions and elucidations of problems in the field of research management.

Research Management will appear in four issues, each of approximately 64 pages, annually. Subscription price, $7.50 per year.

The proper organization and management of research presents many problems which are of common interest to managers in widely different fields. Such problems include: organization and functional operation of research departments; design and construction of laboratories; personnel selection, training, compensation, and maintenance of morale; creative thinking; project selection, scheduling and control; evaluating the results and selling research to management; budgeting and accounting; and the integration of research into the company's operations.

Important ideas, contributing to solutions of these problems, have been generated by Industrial research Institute, through its meetings and other activities. The new journal will contain articles on relevant problems by top research men in the United States (representatives of the member companies of the Institute).

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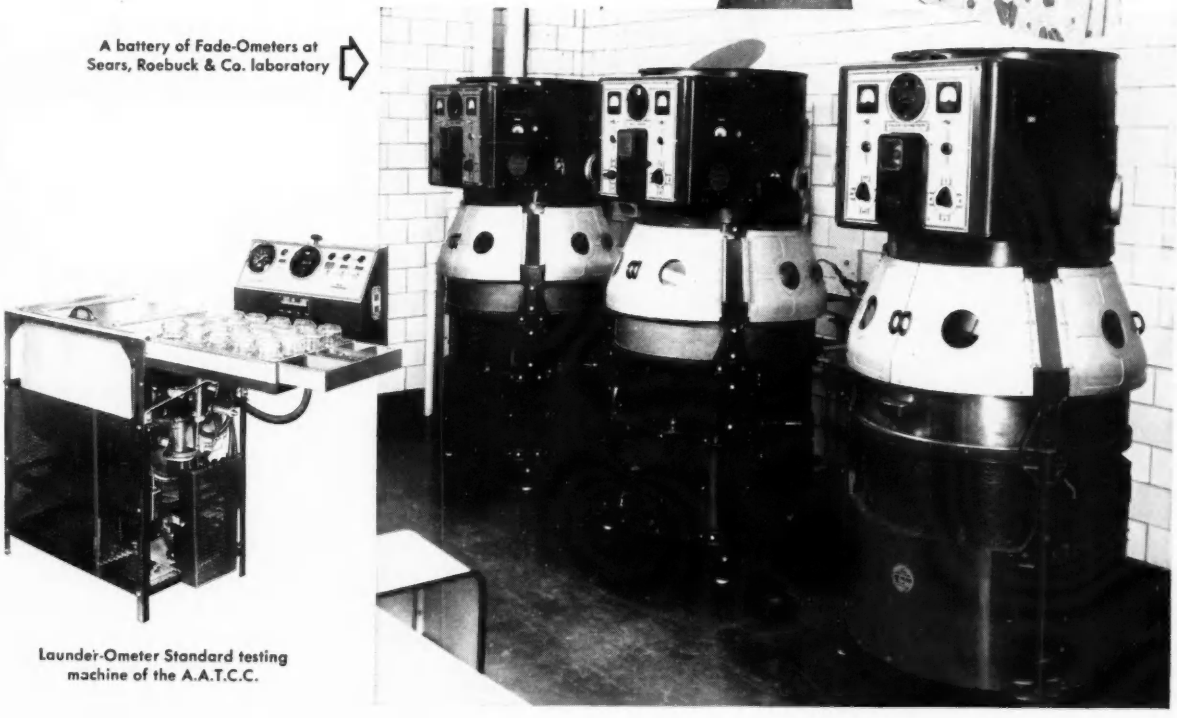

Launder-Ometer Standard testing machine of the A.A.T.C.C.

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Catalin field representatives, experienced in the processing problems of the textile industry, welcome the opportunity to submit samples and discuss the cost-cutting and quality advantages of Resin 8171. Inquiries invited.

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13 Spongers Licensed by 3M to Apply Scotchgard

Thirteen spongers in 11 major US cities have been licensed by Minnesota Mining and Manufacturing Co to apply Scotchgard brand stain-repeller, an oil- and water-repellent fluoro-chemical finish, to upholstery, drapery, and apparel fabrics.

The finish is being used at the mill level by such firms as Forstmann, Pacific Mills, Milliken, Peerless, Burlington Decorative, J P Stevens, and Mooresville Mills to treat both men's and women's wool, worsted, and worsted-synthetic blend apparel fabrics and upholstery fabrics of many types, including cotton prints.

Sponger application is aimed mainly at the piece-goods business originating from the garment industry, department and dry good stores, jobbing houses, decorators, and the general public.

Licensed spongers are Artex Shrinkers, Inc, New York; Geltman Sponging Co, Inc, with plants at Cleveland, Minneapolis, Los Angeles, San Francisco, and Portland, Ore; Manhattan Sponging Co, St Louis; Maxwell & Rothschild, Cincinnati; Perma-Dry, New York; Schwarzwaelder Co, Philadelphia; Southeastern Textile Shrinking Co, Atlanta; Synthetic Finishing Co, Philadelphia; and Western Piece Dye Co, Chicago.

There are few restrictions as regards application of the stain-repeller, these spongers report, except that colors must be fast and the fabric must not resist rewetting because of finishing agents previously applied.

Model application procedure resembles that employed by Geltman at Minneapolis, first sponger to use the stain-repeller:

Here, fabrics received are pretested for reaction to the stain-repeller. They are then examined for defects, measured, and butt-seamed ready for running through a Hunter padder and drier. (Figure 1).

A horizontal conveyor carries the fabric in a tensionless position through the stainless steel, two-compartment wetting-out tank of the padder. (Figure 2). Swatches of the fabric are checked to insure 75 percent wet pickup of the stain-repeller.

At a rate of 8 yards per minute, the fabric moves between pneumatically controlled squeeze rolls set at a pressure of 30 pounds per square inch, past a flog brush that takes off any foreign matter, and to the 3-section drier in which another tensionless conveyor carries it for 8 minutes through a set temperature of 265°F. (Figure 3).

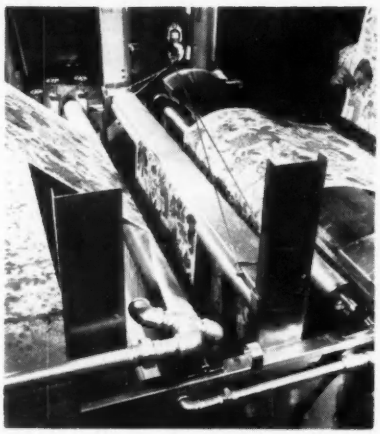


Figure 2

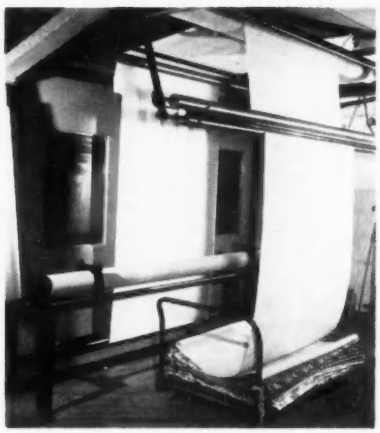


Figure 3

After leaving the drier, the fabric is re-examined and measured; swatches are checked for spray-rating and oil-repellency. The fabric is then decated and pressed, ready for shipping.

Average time elapsed between delivery of fabric at the sponger for the stain-repeller treatment and its return is 48 to 72 hours, Geltman reports.

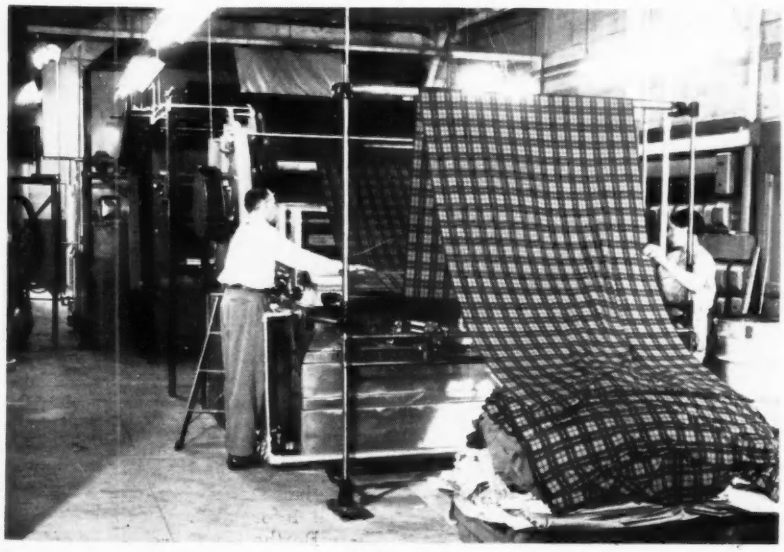


Figure 1

Holds Industry Demand for Good Executives Continues

The current business slowdown has not eased the demand for good executives, according to Thorndike Deland, senior partner of Thorndike Deland Associates, reputedly the nation's oldest executive recruiting firm. Mr Deland, speaking last month to the New York Alumni Chapter of Phi Psi, professional textile fraternity, said, "In tough times, good men are at a premium. Companies which are not in trouble need good men to remain in a sound position, and companies that have been hit need good executive talent to climb back. In the last three months our firm has placed 20% more executives than during the same period last year."

Mr Deland, whose remarks were titled "How To Get Ahead in the Textile Business," cautioned against hasty moves by young men anxious to move up. "Don't walk out of any job in a huff, or you'll weaken your position in at least two ways. First, you won't make any friends and you'll also lose the chance for a helpful reference. Second, you'll be out of work while looking for a new position, and this looks suspicious unless your company has just been through a merger or you have some other equally plausible reason."

Dow Begins Volume Production of Methylacetylene-Propadiene

Volume production of methylacetylene-propadiene, a chemical intermediate, has been started by The Dow Chemical Company. This is the first time the product has been available in commercial quantities, according to Dow.

Methylacetylene-propadiene is a noncorrosive liquified petroleum gas. The material is a mixture of methylacetylene (about 70 percent by weight) and its isomer, propadiene (about 30 percent by weight).

Application of the product as an intermediate for methacrylonitrile, methacrylates and propargyl alcohol appears to be a definite possibility.

Methylacetylene-propadiene reportedly has been found to undergo numerous reactions similar to those of its homolog, acetylene. In general, it is possible to produce propenylation, 1-propynylation, 2-propynylation and propylidenation reactions with the mixture. These compare with the vinylation and ethynylation reactions of acetylene.

In numerous cases, methylacetylene propadiene is said to react in a manner similar to that of its corresponding alkene, propylene. However, methylacetylene-propadiene reportedly has more affinity for nucleophilic fragments (alcohols, amines, water, etc) and offers the possibility of two-mole addition products.

The tank-car price of methylacetylene-propadiene is 23 cents per pound.

"Host" Franchise to A Beshar & Co

One of the nation's leading rug cleaners and carpet dealers, A Beshar & Co, 73 East 52nd St, has been selected as the franchise for the new Host Carpet Drycleaning method for metropolitan New York.

Developed over the past eight years by Racine Industrial Plant, Racine, Wis, Host underwent a major marketing test last year in Washington, DC. Consumer reaction reportedly proved so favorable that Host is now available through professional rug cleaners in most of the nation's larger metropolitan areas. The process comprises a new machine, the Host Electric Upbrush, and a new cleaning compound, Host Drycleaner for Carpeting.

The most significant features of Host are said to be that it is easy to use, cleans by removing dirt, restores crushed carpet texture, and leaves room ready for instant use with no wait for drying.

Host is described as the first method for cleaning wall-to-wall installations which is used by leading professional rug cleaners and rented by the same cleaners to people who wish to do their own drycleaning. It is claimed that renting frequently saves these customers over half the cost of professional cleaning.

Heart of the Host Electric Upbrush is two cylindrical brushes. These revolve in such a way as to raise and unmat crushed carpet pile. They reach to the base of the carpet and, with the drycleaning compound, brush absorbed dirt up to the carpet surface, where it is easily vacuumed away.

It is claimed that the drycleaning compound creates no dust, fumes, or fire hazard; will not shrink or fade carpeting; and cannot cause rust spots or water stains.

MIT Summer Programs in Textiles

Massachusetts Institute of Technology, Cambridge, Mass, is offering two one-week special summer programs in textiles this August.

This first, "Techniques in Textile Research," will emphasize the planning and analysis of experiments and will review current research techniques utilizing polarized light, modern instrumentation, variance analysis, differential geometry and microscopy. There will be laboratory demonstrations to cover the selection and handling of equipment and the integration of optical with physical and chemical techniques. The Program will be given from Monday, August 18, through Friday, August 22, during MIT's 1958 Summer Session.

This Program is under the supervision of Professor Edward R Schwarz, in charge of the Textile Division of the MIT Department of Mechanical Engineering. Lectures and discussion sessions will also be conducted by Stanley Backer, associate professor of mechanical engineering, together with other members of the Textile Division staff.

The 2nd program, "The Mechanics of Textile Structures," will be given from August 25-29. It is planned for industry and government personnel concerned with the design and development of textile products. It will deal with the mechanical properties of textile materials, starting with the behavior of individual fibers and treating fiber configurations within the finished product.

This program will be under the supervision of Dr Backer. He will be assisted by Prof Schwarz and other staff members and guest lecturers.

For further information about each program, write direct to Prof Schwarz or Dr Backer at MIT.

Library of Congress Changes Titles of Two Monthlies

The names of two Library of Congress monthly publications, which serve as keys to new literature coming into this country from the USSR and East Europe, have been changed from "Lists" to "Indexes." The purpose of the change is to indicate to scientists and other scholars not familiar with the monthlies that they are more than mere "booklists" and that they contain information about the content of new Russian and East European books and articles.

The *Monthly List of Russian Accessions*, which entered its 11th year of publication in April, has become the *Monthly Index of Russian Accessions*. The Government Printing Office sells it for $12 a year ($15 abroad).

The *East European Accessions List*, published since 1951, has become the *East European Accessions Index*. The GPO sells it for $10 a year ($12.50 abroad).

The change in the names of the two bibliographies does not mean a change in the editorial content of either one. They contain information *about* the content of books and articles, *not* translations of entire books and articles.

Each index gives, in English, a monthly account of new material in a variety of subject fields as received from the USSR and East Europe by the Library of Congress and by other American research libraries. The translation of all titles of books and articles into English and the elaborate subject guides in English permit a researcher who has no command of Russian or East European languages to identify easily the material important to him.

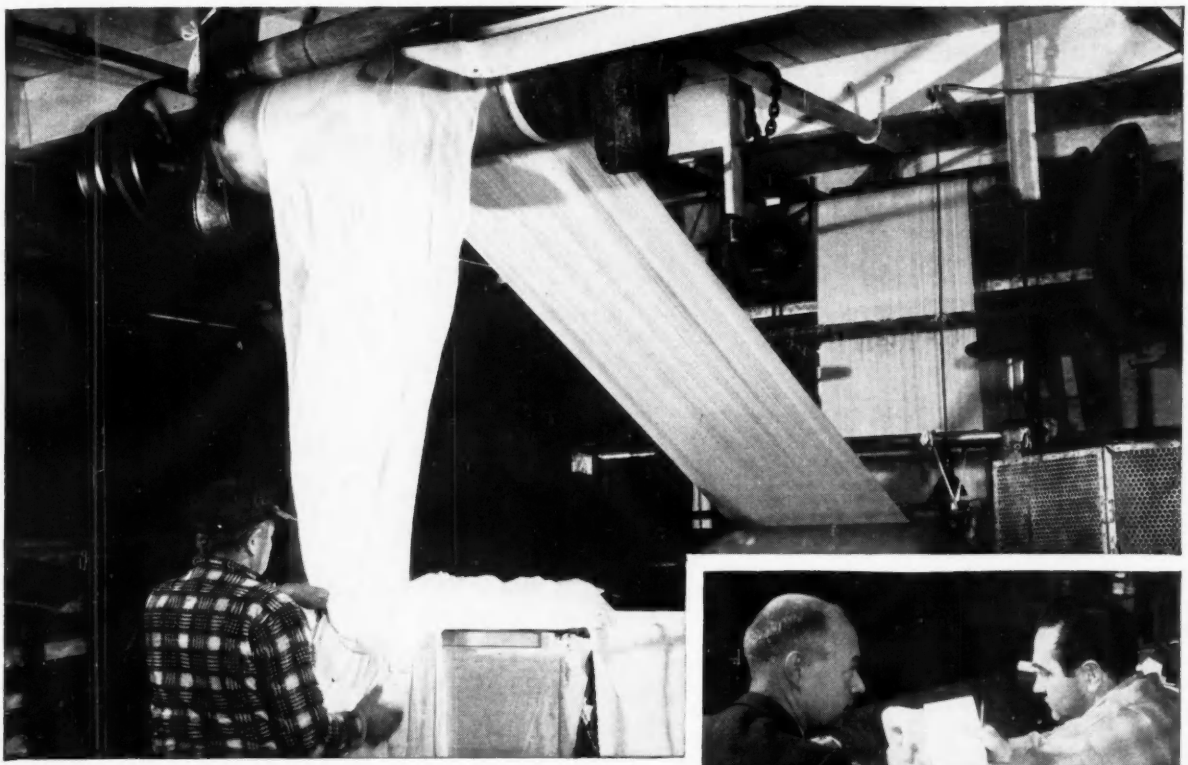
Both publications are prepared in the Library's Processing Department, which is responsible for acquiring materials for the Library's collections and for cataloging them.

New Annex Provides Added Space for STE

Another one-story masonry annex to Greenville's Textile Hall is being built for the 20th Southern Textile Exhibition to meet increasing demands for exhibit space. The Exhibition, a biennial show, will be held at the permanent South Carolina site October 6-10.

The 1950 exposition accommodated 307 exhibitors, including virtually every major manufacturer of basic textile processing machinery and equipment in every part of the nation. Attendance was estimated at 37,000.

Full information may be obtained from Bertha Green, secretary of Textile Hall Corp, Greenville, SC.



• Bleached "rope" of cloth is spread out before trip to drying cans. (Inset) Mr. E. R. Rand (right), Dale Brook V. P., and Du Pont technical man, who worked with Dale Brook, compare samples of cotton goods before and after bleaching with Du Pont's Solo-Matic peroxide bleaching process.

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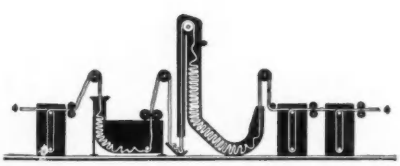
using existing equipment and Du Pont SOLO-MATIC bleaching process



Du Pont's Solo-Matic process—the most advanced single-stage hydrogen peroxide bleaching process available.

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"These gains were made without adding any costly new equipment, or losing any production during the change-over," says Mr. E. R. Rand, V.P. & General Manager of Dale Brook Finishing Co., Inc., Div. of Dubin-Haskell-Jacobson, Inc., Hohokus, N. J. "Common-sense technical service," he continues, "helped us make the change. The Du Pont representative worked closely with us and showed us exactly how we could switch to the Solo-Matic peroxide bleaching process, using our present equipment."

Du Pont's Solo-Matic peroxide bleaching process can offer *you* similar advantages with additional savings in steam, time and water, using your existing equipment. Or if increased production is not your problem, the Du Pont Solo-Matic process helps you maintain your present production levels in *half* the plant space required for conventional two-stage systems. If you plan to install new bleaching equipment . . . or alter your present setup...it will pay you to contact your Du Pont representative or write us at the address below for the complete Solo-Matic story.

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Peroxygen Products Division

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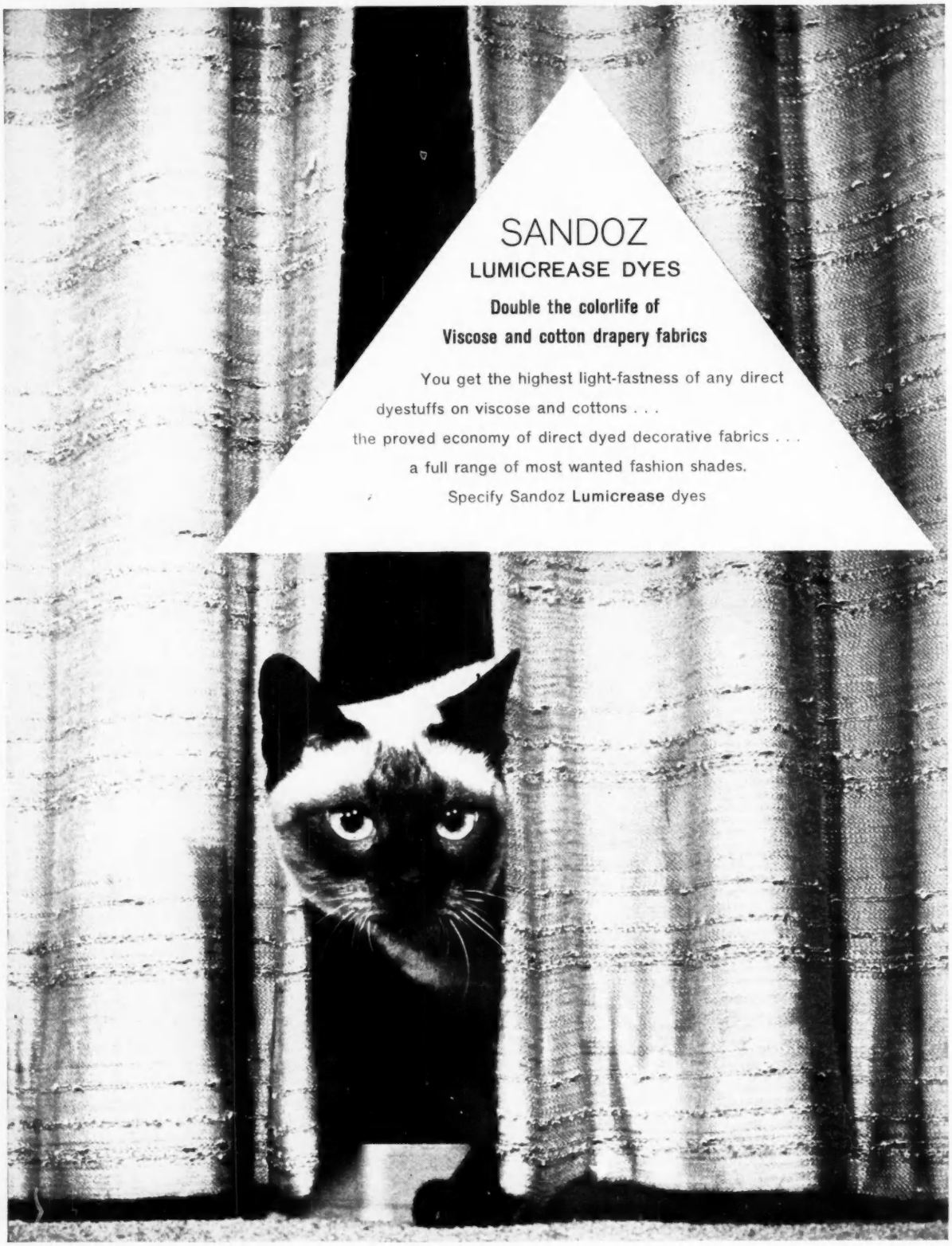
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Photo by Walter Chandoha

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Emery Relocates Philadelphia Office

Emery Industries, Inc, has moved its Philadelphia sales office to 4343 East River Drive. The office was previously located at 401 N Broad St.

The expanded facilities reportedly will enable Emery to offer increased service to greater Philadelphia accounts, and will serve as headquarters for J P Clancy, Eastern District sales manager of Emery's Organic Chemical Sales Department, and J P Kramer, sales representative of the Fatty Acid Sales Department.

Argentine Source of Tapioca Starch

Raul Pedro Fernicola e Hijos y Cia SRL, Buenos Aires, Argentina, manufacturer of tapioca flour (known also as tapioca starch) advises that it can export to the United States between 50 and 60 tons of starch a month. This quantity will most likely rise in the future as the firm augments its existing production facilities.

The firm offers to send samples, while requesting that those interested inform them on quotable prices, conditions of payment, shipment, etc.

Replies should be addressed to Rodriguez Pena 434, Buenos Aires.

New NDC Equipment

Northern Dyeing Corp, Washington, NJ, has purchased two new pieces of equipment, which, according to Frank J Percarpio, NDC president, "gives us great versatility and enables us to take more of the finer quality fabrics."

The Company, which is an authorized licensee for Cluett, Peabory's "Sanforized" process, has invested $75,000 in the latest type compressive shrinkage unit built by Morrison Machine Co. The machine has numerous refinements, including a 2⅝" rubber blanket.

Northern is expecting delivery shortly of a new gas-fired loop dryer from National Drying Machinery Co, which, it is claimed, will afford the maximum in relaxed air drying. The dryer is said to be especially important in the processing of goods that are to be made shrink-resistant. It is also said to be a necessity when the finisher wishes to preserve the natural texture or loft of a fabric, a factor of significance at Northern where most materials are dyed on the virtually tension-free Swedish Pad-Roll machine.

The addition of both pieces of equipment reportedly will make it possible to fully utilize all the advantages of the pad-roll machine.

Givaudan Names New Sales Agents

R E Horsey, vice president in charge of sales, has announced the appointment of Durkin Chemicals, Inc, as sales agents in Washington and Oregon for Givaudan-Delawanna, Inc, Givaudan Flavors Inc, and Sindar Corp. The new agent of the Givaudan organization will be located at 2603 Second Avenue, Seattle 1, Wash.

Effective May 19, the executive and sales offices and service laboratories of Sindar Corporation will be located at 321 West 44th St, New York 36, NY. The new telephone number will be CIrcle 5-0310.

The new facilities will include larger service laboratories, equipped with the most modern apparatus.

LTI Offering 115 Scholarships

Lowell Technological Institute has 115 scholarships valued at $27,000 available next fall, 25 of which are open to freshmen. In addition there are four fellowships with a total value of $5100 for which applications now are being accepted.

Scholarships are open in chemistry, textiles, plastics, paper, leather, electronics, physics and allied fields.

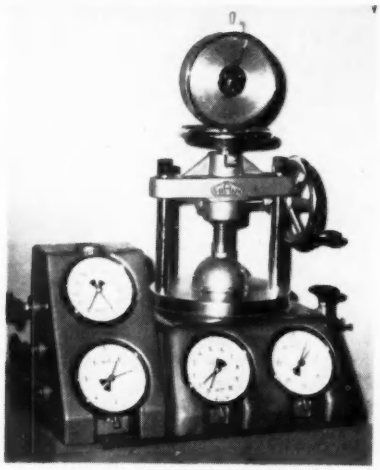
• NEW PRODUCTS AND DEVELOPMENTS •

Improved Bursting Strength Tester

Karl Frank GmbH, Weinheim-Birkenau, Germany, has brought out an improved Bursting Strength Tester, in which the scale is divided into more measuring ranges. Two further pressure gauges are used so that the following measuring ranges can be obtained: 0—1 kg/sq cm; 0—6 kg/ sq cm; 0—10 kg/sq cm; and 0—30 kg/ sq cm.

The pressure gauges are connected in parallel and the pressure gauges 0—1, 0—6 and 0—10 kg/sq cm be switched on or off by operating a valve. The pressure gauge 0—30 kg/sq cm serves as a control instrument.

The Bursting Strength Tester consists of a sturdily built base made of cast iron. The precision pressure gauges are located in the base. The control and reduction valve is fitted to the right side of the machine. Two strong steel columns connect the base with the cross-head of cast iron. The interchangeable clamping device is fitted to the bottom of the cross-head, whereas the convexity height gauge



Frank Bursting Strength Tester

is situated on its top. The height adjustment device is located on the right side of the cross head.

The clamping device serves for pressing the test specimen against a clamping plate. This is facilitated by a worm gear. After loosening a fixing device, one can move the clamp very quickly.

The necessary compressed air may be supplied by a compressor or by a compressed air reservoir. A rubber diaphragm is situated between the clamping plate and the test specimen. At break of test specimen the pressure exerted on the diaphragm is released by a valve.

Flamort-U

Flamort-U, one of a family of flameproofing compounds manufactured by Flamort Chemical Co, 746 Natoma St, San Francisco 3, Calif, is a special fire retardant for cellulose acetate and nylon, which is manufactured in concentrated crystalline form.

Registered at the office of the California State Fire Marshal under Reg Nr C-4-7, the flameproofing solution is usually prepared by dissolving three pounds of Flamort-U compound per one gallon of water. Application is by either spraying or immersion.

Samples and technical literature are available on request.

Moth Snub D

A new mothproofing agent, which is said to be highly durable, has recently been introduced by the Arkansas Co, Inc, Newark, NJ. The new product, Moth Snub D, reportedly contains as its active ingredient, hexachloro-epoxyoctahydro-endo-exo-dimethanonaphthalene.

The following advantages of the product, which is claimed to be "outstanding in this field," are cited by Arkansas Co, Inc:

1) Easily applied during dyeing.

2) Durable for life of garment to drycleaning, to laundering, and to weathering including exposure to rain and sun. It is also resistant to perspiration, hot pressing and abrasion.

3) Does not affect the hand or appearance of the fabric.

4) Does not cause odor development even under extreme conditions.

5) Highly economical in that extremely small amount of the active ingredient gives complete protection against moth and carpet beetle larvae.

Moth Snub D is said to be simple to use and does not require any preliminary mixing before adding to the dyebath.

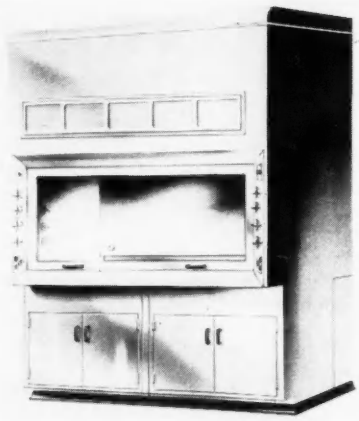
In physical consistency, it is a stable, white emulsion, which is added directly to the dyebath at the start of the dyeing operation. The dyeing is then carried out in the usual manner during which the mothproofing agent is exhausted onto the goods at the same time as the dyes. It is stated that, in most applications, it is necessary to use only 4% Moth Snub D on the weight of the fabric.

Fisher AirFlow Fume Hood

The Fisher AirFlow Fume Hood, a product of Fisher Scientific Co. 316 Fisher Bldg, Pittsburgh 19, Pa, offers gently curved vertical panels and horizontal deflector vanes at the face of the 6-ft-wide hood, which are designed to admit air in a smooth, unbroken pattern.

This "air flow" feature of the Hood reportedly enables it to operate with equal safety at one-half the speed of conventional hoods. The air foil across the front directs incoming air across the work surface, and sweeps fumes back to the lower baffle opening. The 1" air space between air foil and ledge of the work surface is always open, to insure constant air flow.

A "bypass" grille at the top of the face assures that the Hood cannot be starved off when the sash is closed. This bypass also controls the maximum air velocity through the face of the Hood as the sash approaches the closed position, enabling the Hood to withdraw a constant volume of air.



The bypass is automatic, without moving parts to service; its operation is controlled entirely by the sash position.

The AirFlow Hood is supplied partially assembled and complete except for Transite exhaust ducting (which labs may order separately to fit individual needs). It operates on 115-volt 60-cycle a-c.

The 16-gauge steel unit is 108" high, 72" wide, 37" front-to-back, with a totally enclosed ¼-hp 860-rpm motor-&-blower set capable of moving 870 cu ft air/min against ¼" static pressure.

The work surface is 1¼" thick, 100% synthetic Kemstone with a fitted 3" x 6" sink; the counterbalanced sash is ¼" safety glass; and there is a two-tube fluorescent light.

Mounted on the vertical face panels of the Hood are 8 eye-level remote controls for the service fixtures and 4 outlets for 115-volt a-c, 2 for 230-volt a-c. The Hood's base has two cupboard units with adjustable shelves.

US price of the Fisher AirFlow Fume Hood: about $1490.

Hydrocop & 3B Softener

Laurel Hydrocop & 3B Softener, for conditioning and lubrication of knitting yarns, is now being offered by Laurel Soap Mfg Co. Suitable for natural, bleached, or dyed yarns, they are said to be easily prepared and to form stable emulsions for application from emulsion troughs or any standard coning or winding machine.

Numerous advantages of Laurel Hydrocop & 3B Softener cited by the manufacturer include: lubricating the yarn to assure smooth running and even stitches; giving a softer, better cone which reduces the number of pulls and sloughs off the cone; and conditioning the yarn to make it stronger with fewer breaks. Reportedly providing excellent results on all natural, synthetic, and blended spun yarns (particularly cotton, wool, worsted, cashmere, and Orlon), they are said to cause no odor or color changes and to be readily removed in a regular scour or boil-off. They won't interfere with later dyeing, bleaching, or finishing, it is claimed.

Free sample and detailed working instructions may be obtained from Laurel Soap Mfg Co, Inc, Tioga, Thompson, and Almond Streets, Philadelphia 34, Pa.

Eastman Fast Blue B-GLF

Eastman Fast Blue B-GLF has been announced by Eastman Chemical Products, Inc, subsidiary of Eastman Kodak Company. As the nomenclature indicates, the colorfastness properties of the new dye place it in Eastman's top line of dyes for acetate fibers, the GLF series.

It is claimed that, in addition to excellent resistance to atmospheric and light fading, laboratory and commercial tests have proved the new dye to also provide excellent resistance to washing, perspiration, hot pressing, urea-formaldehyde resins, drycleaning and sublimation.

The new dye is described as being highly dispersed and suitable for use on acetate, triacetate, and polyester fibers. On polyester fibers, Eastman Fast Blue B-GLF reportedly may be dyed with a carrier or by high-temperature methods; on acetate and triacetate fibers conventional methods may be followed. On all three fibers excellent dispersion and levelling are claimed.

Eastman anticipates that the new dye will be particularly useful in combination shades for men's suitings, dress goods, upholstery and drapery fabrics and outdoor wear.

Sandoz Cuprofix Navy C-LW paf

Cuprofix Navy C-LW paf, an after-treated direct navy, is being recommended by Sandoz, Inc to the cotton knitgoods trade for shades with maximum resistance to repeated washings. In a recent letter to the trade, A T Hanes, vice-president of Sandoz, Inc, points out that information on the fastness of this color is especially valuable in view of the emphasis on machine-washable fabrics. Knitgoods dyed with this navy reportedly have withstood repeated washings at 160°F with soap and soda ash, without any significant degradation of colorfreshness, or fastness to light, perspiration, and crocking. Sandoz is offering mill-dyed samples of the navy for comparative tests by knitgoods dyers.

New Syl-mer Applications

Five new applications of Syl-mer, a water-repellent, spot-and-stain-resistant silicone finish, especially for synthetics, blends, wool, cottons, worsteds, and fur-like pile fabrics, have been announced by Dow Corning Corporation.

The first new silicone emulsion, developed for synthetics and blends, reportedly will permit treatment of fabrics at either shorter curing times at high temperatures or normal curing times and lower temperatures. Previously, Syl-mer characteristics could be attained only when drying and curing at temperatures of above 300 F.

A second new Syl-mer product, for woolens and worsteds, reportedly allows wool finishes to cure at lower temperatures and still realize all the advantages of the silicone finish. Any equipment which can dry the fabrics will cure the finish, the company reports.

Another new finish for wools can be applied by exhausting into the fabric in a dye beck or dolly washer, eliminating the need for padding. According to Dow Corning, the Syl-mer properties are developed at drying temperatures which are acceptable even to the most cautious wool finisher. One of the interesting new uses for this product is on knitted wool jersey.

A new application of Syl-mer for synthetic and cotton blends will make its first appearance in women's full-fashioned and seamless hosiery, it is reported. Excellent hand and resistance to water spotting are features most mentioned by hosiery manufacturers currently evaluating the new finish, Dow Corning states.

Said to be equally significant is a new Dow Corning silicone emulsion developed for deep pile fur-like fabrics, such as the new 100 Dynel and Dynel-Orlon coating fabrics. This treatment, soon to be identified under the Syl-mer name, reportedly may be at the picker, thus allowing the silicone to be effective as a lubricant in knitting. It can also be sprayed onto the fabric just prior to its passing through conventional pile finishing equipment.

According to F L Dennett, manager of the Fiber Treatment Section in the Product Engineering Laboratories of Dow Corning, each of these new applications has resulted from a need for a product which could be applied with ease, without new and complicated methods and without requiring the finisher or mill to purchase other materials not supplied as a one-priced package with the finish.

Mr Dennett explained that "continuing research by a staff of trained chemists and engineers familiar with the problems of the textile industry, as well as the properties of silicones, has resulted in new emulsification systems and catalyst combinations that make each of these specialized applications possible."

"No new product, or method of application, is given the Syl-mer name until it has been demonstrated by field trials to be practical. It must produce a quality finish which will meet the rigid standards of performance set up for the Syl-mer program.

"Each application has been studied, and quality control tests developed, where no standard tests apply, to effectively measure the performance of the finish for the intended end use.

"Each new user must be convinced of the value of the new finish of his choice and must have demonstrated his desire to maintain continuing quality standards before he is offered a license which allows his product to bear the distinctive black and gold Syl-mer tag."

Further information on the new silicone finish applications and other uses for Syl-mer in apparel and home furnishing textiles may be obtained from Dow Corning Corp, Midland, Michigan.

Heat-Retention-Type Electrode

The prospect of arcless application of dielectric high frequency heating in many textile operations reportedly has been brought a step closer as a result of two broad patents issued to Julius W Mann and George F Russell of Tacoma, Wash, on a new type of apparatus which the inventors call the Heat-Retention-Type Electrode.

Patent No. 2,821,611 describes various types of electrodes to be used primarily in evaporating moisture from moving webs of textiles and other materials, where arcing tendencies would be ruinous to the quality of the end products. This patent points out particularly where moving webs of parallel strands of rayon and other fibrous materials may be dyed and dried during the process of putting the yarn into production, rather than in the separate and expensive batch-type dyeing operations, which involve many stages of winding and rewinding of cones.

The electrodes developed by Mann and Russell reportedly are composed of multiple metallic elements separated by thin layers of high loss dielectric, which retains some heat and permits operation of warm, rather than cold electrode units. The electronic generator, which supplies energy to the electrodes, is connected to a metallic element separated physically from the idler contact touching the work, and it is described as suppressing a high-frequency arcing tendency, so treacherous in older electrode forms.

By running at a naturally warm temperature, the patents point out, the new electrode types, when made from hard aluminum or stainless steel have a natural repelling action for an adhesive which otherwise might adhere to and build up upon the old cold-type electrode applicators.

The type of electrodes described for use with textiles is said to have the quality of repelling any tendency of the moisture once evaporated from the moving web to recondense on the electrode elements themselves and thereby eliminating RF flash-back or redelivery of moisture vapor to the web. Chimney-type ovens incorporating a multiplicity of heat-retention-type finger electrodes have permitted placing extremely high charged fields of force in direct contact with rayon without the slightest arcing tendencies, it is claimed.

The patents will be licensed non-exclusively to users and manufacturers who might wish to employ them in their various applications, such as the continuous process of drying of dye and adhesives for rayon yarns and in other textile dyeing and drying operations. The new electrode elements were developed in the laboratories of Mann-Russell Electronics, Tacoma, Wash.

Tinon Grey 2GR-F Paste

A new vat grey which is said to give exceptionally level dyeing results of pastel grey shades on cotton and rayon packages and beams has been brought out by Geigy Dyestuffs, Division of Geigy Chemical Corp.

The new coloring material, known as Tinon Grey 2GR-F Paste, is classified by the producer as a homogenous grey, giving very good exhaustion, excellent lightfastness, good wash resistance and good dispersibility.

According to the manufacturer, the level dyeing of pastel grey shades has always been a problem with the older vat greys and this new dyestuff, with its low initial striking rate, provides relief from this dyehouse problem.

Bulletin V-38, which describes the properties of Tinon Grey 2GR-F Paste in detail, and includes dyeing instructions and color samples, will be available shortly to customers from Geigy representatives, branches or from Geigy's main office, PO Box 430, Yonkers, NY.

• NAMES IN THE NEWS •

Schlaeppi

Luskin

Moore

Grant

Zelek

Lamendola

Ciba Co, Inc has promoted **Fernand Schlaeppi** to the new post of technical manager of the New England District, with offices in Rumford, RI.

He was formerly chief technician for Ciba in New England.

Appointment of **R G Luskin** as West Coast district manager for its Chemical Division has been announced by the Goodyear Tire & Rubber Co.

With headquarters in Los Angeles, Luskin will be directly responsible for all sales and technical service activities emanating from the Chemical Division's Los Angeles, San Francisco and Portland offices. Prior to this latest assignment he had been special representative servicing accounts in the Southwest.

American Cyanamid Co has announced the following appointments in its Organic Chemicals Div:

J E Moore has been named assistant to the manager of the dyes department. Mr Moore joined Cyanamid's Charlotte sales office in 1931 and has served since in many sales capacities.

R W Angstadt, who has served as sales manager of the textile resin department in Charlotte since 1947, has been named southern manager of the dyes department.

Q M Rhodes, associated with the Charlotte sales office since 1940, has been named southern manager of the textile chemicals department.

J N Grant, with Cyanamid since 1931, has been appointed a sales assistant in the dyes department.

John A Zelek, formerly divisional vice president of Interchemicals Corporation's Color and Chemicals Division, has joined The Harshaw Chemical Co as technical director of its Dyes and Fine Chemicals Division. He will be located at the Company's Zinsser Plant at Hastings on-Hudson, NY.

Warwick Chemical Division of Sun Chemical Corporation has announced the appointment of **Charles A Lamendola** as technical sales representative for the New England area. Mr Lamendola has been with the Warwick Chemical Division for the past three years, serving as office manager, credit manager and assistant to the sales manager.

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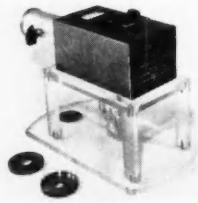

Model CS-66

The ELECTROSTATIC VOLTMETER (CS-66) was developed by the Institute of Textile Technology to detect and measure electrostatic charges on moving or stationary equipment or materials.

The ELECTRICAL RESISTANCE TESTER (CS-51) has been developed for measurement of electrical resistance of fabrics, fibers, film and other materials to determine the static propensities of the materials.

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Model CS-51

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